NVIDIA ConnectX-6 Dx Ethernet Adapter Cards User Manual

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About This Manual

This User Manual describes NVIDIA® ConnectX®-6 Dx Ethernet adapter cards. It provides details as to the interfaces of the board, specifications, required software and firmware for operating the board, and relevant documentation.

Ordering Part Numbers

The table below provides the ordering part numbers (OPN) for the available ConnectX-6 Dx adapter cards designed to fit into Half-Height, Half-Length (HHHL) slots.

Configuration	NVIDIA SKU	Legacy OPN	Marketing Description
25GbE with Active Cooling Cards	900-9X663-0073-SQ0	MCX621202AS-ADAT	ConnectX-6 Dx EN adapter card, **25GbE**, **with active cooling**, **Dual**-port **SFP28**, PCIe 4.0 **x8**, **Secure Boot**, No Crypto, Tall Bracket
	900-9X663-0083-SQ0	MCX621202AC-ADAT	ConnectX-6 Dx EN adapter card, **25GbE**, **with active cooling**, **Dual**-port **SFP28**, PCIe 4.0 **x8**, **Crypto and Secure Boot**, Tall Bracket
100GbE Cards	900-9X6AG-0086-ST0[(a)]	MCX623106AC-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, **Dual**-port **QSFP56**, PCIe 4.0 **x16**, **Crypto and Secure Boot,** Tall Bracket
	900-9X6AG-0056-ST1	MCX623106AN-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, **Dual**-port **QSFP56**, PCIe 4.0 **x16**, No Crypto, Tall Bracket
	900-9X6AG-0076-ST0	MCX623106AS-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, **Dual**-port **QSFP56**, PCIe 4.0 **x16**, **Secure Boot**, No Crypto, Tall Bracket
200GbE Cards	900-9X6AG-0018-ST0	MCX623105AN-VDAT	ConnectX-6 Dx EN adapter card, **200GbE**, **Single**-port **QSFP56**, PCIe 4.0 **x16**, No Crypto, Tall Bracket

Note:
[(a)] If your target application for this crypto-enabled card will utilize 100Gb/s or higher bandwidth, where a substantial part of the bandwidth will be allocated for IPsec traffic, please refer to the NVIDIA ConnectX-6 Dx Cards Product Release Notes document to learn about a potential bandwidth limitation. See Related Documents section for details on accessing the document.

Legacy (EOL) Ordering Part Numbers

Legacy OPN	Marketing Description
MCX623102AS-ADAT	ConnectX-6 Dx EN adapter card, **25GbE**, **Dual**-port **SFP28**, PCIe 4.0 **x16**, **Secure Boot**, No Crypto, Tall Bracket
MCX623102AS-ADAT	ConnectX-6 Dx EN adapter card, **25GbE**, **Dual**-port **SFP28**, PCIe 4.0 **x16**, **Secure Boot**, No Crypto, Tall Bracket
MCX621102AN-ADAT	ConnectX-6 Dx EN adapter card, **25GbE**, **Dual**-port **SFP28**, PCIe 4.0 **x8**, No Crypto, Tall Bracket
MCX621102AC-ADAT	ConnectX-6 Dx EN adapter card, **25GbE**, **Dual**-port **SFP28**, PCIe 4.0 **x8**, **Crypto** and **Secure Boot**, Tall Bracket
MCX623102AC-ADAT	ConnectX-6 Dx EN adapter card, **25GbE**, **Dual**-port **SFP28**, PCIe 4.0 **x16**, **Crypto and Secure Boot**, Tall Bracket
MCX623102AN-ADAT	ConnectX-6 Dx EN adapter card, **25GbE**, **Dual**-port **SFP28**, PCIe 4.0 **x16**, No Crypto, Tall Bracket

Legacy OPN	Marketing Description
MCX621102AE-ADAT	ConnectX-6 Dx EN adapter card, **25GbE**, **Dual**-port **SFP28**, PCIe 4.0 **x8**, **Crypto**, No Secure Boot, Tall Bracket
MCX623102AC-GDAT	ConnectX-6 Dx EN adapter card, **50GbE**, **Dual**-port **SFP56,** PCIe 4.0 **x16**, **Crypto and Secure Boot,** Tall Bracket
MCX623102AN-GDAT	ConnectX-6 Dx EN adapter card, **50GbE** , **Dual**-port **SFP56**, PCIe 4.0 **x16**, No Crypto, Tall Bracket
MCX623102AE-GDAT	ConnectX-6 Dx EN adapter card, **50GbE**, **Dual**-port **SFP56**, PCIe 4.0 **x16**, **Crypto**, No Secure Boot, Tall Bracket
MCX623102AS-GDAT	ConnectX-6 Dx EN adapter card, **50GbE**, **Dual**-port **SFP56**, PCIe 4.0 **x16**, **Secure Boot**, No Crypto, Tall Bracket
MCX623105AN-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, **Single**-port **QSFP56**, PCIe 4.0 **x16**, No Crypto, Tall Bracket
MCX623106PC-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, **Dual**-port **QSFP56**, with **PPS In/Out**, PCIe 4.0 **x16**, **Crypto** and **Secure Boot**, Tall Bracket
MCX623105AC-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, Single-port **QSFP56**, PCIe 4.0 **x16**, **Crypto and Secure Boot**, Tall Bracket
MCX623105AE-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, **Single**-port **QSFP56**, PCIe 4.0 **x16**, **Crypto**, No Secure Boot, Tall Bracket
MCX623106AE-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, **Dual**-port **QSFP56**, PCIe 4.0 **x16**, **Crypto**, No Secure Boot, Tall Bracket
MCX623109AC-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, Single-port DSFP, PCIe 4.0 x16, **Crypto and Secure Boot**, Tall Bracket
MCX623109AN-CDAT	ConnectX-6 Dx EN adapter card, **100GbE** , Single-port DSFP, PCIe 4.0 x16, No Crypto, Tall Bracket
MCX623106GC-CDAT	ConnectX-6 Dx EN adapter card, 100GbE, **Dual**-port **QSFP56**, **Enhanced-SyncE & PTP GM support and GNSS**, PPS Out, PCIe 4.0 x16, **Crypto and Secure Boot**, FHHL with Tall Bracket
MCX623106TC-CDAT[(a)]	ConnectX-6 Dx EN adapter card, 100GbE, **Dual**-port **QSFP56**, **Enhanced-SyncE & PTP**, **PPS In/Out**, PCIe 4.0 x16, **Crypto and Secure Boot**, FHHL with Tall Bracket
MCX623106GN-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, **Dual**-port **QSFP56**, **Enhanced-SyncE & PTP GM support and GNSS**, **PPS Out**, PCIe 4.0 x16, No Crypto, Tall Bracket
MCX623106PC-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, **Dual**-port **QSFP56**, with **PPS In/Out**, PCIe 4.0 x16, **Crypto** and Secure Boot, Tall Bracket
MCX623106PE-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, **Dual**-port **QSFP56**, with **PPS In/Out**, PCIe 4.0 x16, **Crypto**, No Secure Boot, Tall Bracket
MCX623106PN-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, **Dual**-port **QSFP56**, with **PPS In/Out**, PCIe 4.0 **x16**, No **Crypto**, Tall Bracket
MCX623106TN-CDAT	ConnectX-6 Dx EN adapter card, **100GbE**, **Dual**-port **QSFP56**, with **PPS In/Out**, PCIe 4.0 **x16**, No **Crypto**, Tall Bracket
MCX623105AE-VDAT	ConnectX-6 Dx EN adapter card, **200GbE**, **Single**-port **QSFP56**, PCIe 4.0 **x16**, **Crypto**, No Secure Boot, Tall Bracket
MCX623105AS-VDAT	ConnectX-6 Dx EN adapter card, **200GbE**, **Single**-port **QSFP56**, PCIe 4.0 **x16**, **Secure Boot**, No Crypto, Tall Bracket

Legacy OPN	Marketing Description
MCX623105AC-VDAT[a]	ConnectX-6 Dx EN adapter card, **200GbE**, **Single**-port **QSFP56**, PCIe 4.0 **x16**, **Crypto and Secure Boot**, Tall Bracket

Note:
[a] If your target application for this crypto-enabled card will utilize 100Gb/s or higher bandwidth, where a substantial part of the bandwidth will be allocated for IPsec traffic, please refer to the NVIDIA ConnectX-6 Dx Cards Product Release Notes document to learn about a potential bandwidth limitation. See Related Documents section for details on accessing the document.

Intended Audience

This manual is intended for the installer and user of these cards. The manual assumes basic familiarity with Ethernet network and architecture specifications.

Technical Support

Customers who purchased NVIDIA products directly from NVIDIA are invited to contact us through the following methods:

- URL: https://www.nvidia.com > Support
- E-mail: enterprisesupport@nvidia.com

Customers who purchased NVIDIA M-1 Global Support Services, please see your contract for details regarding Technical Support.
Customers who purchased NVIDIA products through an NVIDIA-approved reseller should first seek assistance through their reseller.

Related Documentation

NVIDIA MLNX_OFED for Linux User Manual and Release Notes	User Manual and Release Notes describing MLNx_OFED features, performance, band diagnostic, tools content, and configuration. See NVIDIA MLNX_OFED for Linux Documentation.
WinOF-2 for Windows User Manual and Release Notes	User Manual describing WinOF-2 features, performance, Ethernet diagnostic, tools content, and configuration. See WinOF-2 for Windows Documentation.
NVIDIA VMware for Ethernet User Manual and Release Notes	User Manual describing the various components of the NVIDIA ConnectX® NATIVE ESXi stack. See VMware® ESXi Documentation.
NVIDIA Firmware Update	NVIDIA firmware update and query utility used to update the firmware. See NVIDIA Firmware Utility (mlxup) Documentation.
NVIDIA Firmware Tools (MFT) User Manual	User Manual describing the set of MFT firmware management tools for a single node. See MFT User Manual.
IEEE Std 802.3 Specification	IEEE Ethernet Specifications
PCI Express Specifications	Industry Standard PCI Express Base and Card Electromechanical Specifications.

NVIDIA MLNX_OFED for Linux User Manual and Release Notes	User Manual and Release Notes describing MLNx_OFED features, performance, band diagnostic, tools content, and configuration. See NVIDIA MLNX_OFED for Linux Documentation.
LinkX Interconnect Solutions	LinkX Ethernet cables and transceivers are designed to maximize the performance of High-Performance Computing networks, requiring high-bandwidth, low-latency connections between compute nodes and switch nodes. NVIDIA offers one of the industry's broadest portfolio of 40GbE, 56GbE, 100GbE, 200GbE and 400GbE cables, including Direct Attach Copper cables (DACs), copper splitter cables, Active Optical Cables (AOCs) and transceivers in a wide range of lengths from 0.5m to 10km. In addition to meeting Ethernet standards, NVIDIA tests every product in an end-to-end environment ensuring a Bit Error Rate of less than 1E-15. Read more at LinkX Cables and Transceivers.
ConnectX-6 Dx Adapters Product Release Notes	Describes the hardware release notes for the ConnectX-6 Dx adapters. The document is available via NVOnline, please contact your NVIDIA representative for access.

Document Conventions

When discussing memory sizes, MB and MBytes are used in this document to mean size in mega Bytes. The use of Mb or Mbits (small b) indicates size in mega bits. In this document PCIe is used to mean PCI Express.

Revision History

A list of the changes made to this document are provided in .Document Revision History.

1 Introduction

1.1 Product Overview

This is the *User Manual* for Ethernet adapter cards based on the ConnectX®-6 Dx integrated circuit device.
As the world's most advanced cloud SmartNIC, ConnectX-6 Dx provides up to two ports of 25, 50 or 100Gb/s or a single-port of 200Gb/s Ethernet connectivity, powered by 50Gb/s PAM4 SerDes technology and PCIe Gen 4.0 host connectivity. ConnectX-6 Dx continues among NVIDIA's innovation path in scalable cloud fabrics, delivering unparalleled performance and efficiency at every scale. ConnectX-6 Dx's innovative hardware offload engines, including IPsec and TLS inline data-in-motion encryption, are ideal for enabling secure network connectivity in modern data-center environments. Please refer to Feature and Benefits for more details.

ConnectX-6 Dx 25GbE Adapter Cards

OPN	Form Factor/ Dimensions	Data Transmission Rate	No. of Ports and Type	PCIe Interface	Secure Boot	Crypto	RoHS	Bracket Type
MCX621102AC-ADAT	4.89in. x 2.71in (124.22mm x 68.90mm)	25/10/1 GbE	Dual-port SFP28	PCIe Gen 4.0 SERDES @ 16.0GT/s x8	✓	✓	✓	Tall Bracket
MCX621102AN-ADAT	4.89in. x 2.71in (124.22mm x 68.90mm)	25/10/1 GbE	Dual-port SFP28	PCIe Gen 4.0 SERDES @ 16.0GT/s x8	-	-	✓	Tall Bracket
MCX621102AN-ADAT	4.89in. x 2.71in (124.22mm x 68.90mm)	25/10/1 GbE	Dual-port SFP28	PCIe Gen 4.0 SERDES @ 16.0GT/s x8	-	-	✓	Tall Bracket
MCX623102AC-ADAT	5.59in. x 2.71in (142.00mm x 68.90mm)	25/10/1 GbE	Dual-port SFP28	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	✓	✓	✓	Tall Bracket
MCX623102AN-ADAT	5.59in. x 2.71in (142.00mm x 68.90mm)	25/10/1 GbE	Dual-port SFP28	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	-	-	✓	Tall Bracket
MCX623102AS-ADAT	5.59in. x 2.71in (142.00mm x 68.90mm)	25/10/1 GbE	Dual-port SFP28	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	✓	-	✓	Tall Bracket

ConnectX-6 Dx 25GbE Adapter Cards with Active Cooling

⚠ These cards are optimized for Workstation Environments and include an onboard cooling fan that meets the acoustic requirements for workstations.

OPN	Form Factor/ Dimensions	Data Transmission Rate	No. of Ports and Type	PCIe Interface	Secure Boot	Crypto	RoHS	Bracket Type
MCX621202AS-ADAT	6.01in. x 2.71in (152.90mm x 68.90mm)	25/10/1 GbE	Dual-port SFP28	PCIe Gen 4.0 SERDES @ 16.0GT/s x8	✓	-	✓	Tall Bracket
MCX621202AC-ADAT	6.01in. x 2.71in (152.90mm x 68.90mm)	25/10/1 GbE	Dual-port SFP28	PCIe Gen 4.0 SERDES @ 16.0GT/s x8	✓	-	✓	Tall Bracket

ConnectX-6 Dx 50GbE Adapter Cards

OPN	Form Factor/ Dimensions	Data Transmission Rate	No. of Ports and Type	PCIe Interface	Secure Boot	Crypto	RoHS	Bracket Type
MCX623102AC-GDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	50/25/10/1 GbE	Dual-port SFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	✓	✓	✓	Tall Bracket
MCX623102AE-GDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	25/10/1 GbE	Dual-port SFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	-	✓	✓	Tall Bracket
MCX623102AN-GDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	25/10/1 GbE	Dual-port SFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	-	-	✓	Tall Bracket
MCX623102AS-GDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	25/10/1 GbE	Dual-port SFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	✓	-	✓	Tall Bracket

ConnectX-6 Dx 100GbE Adapter Cards

OPN	Form Factor/ Dimensions	Data Transmission Rate	No. of Ports and Type	PCIe Interface	Secure Boot	Crypto	RoHS	Bracket Type
MCX623105AN-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/ 10/1 GbE	Single-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	-	-	✓	Tall Bracket
MCX623106AN-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/ 10/1 GbE	Dual-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	-	-	✓	Tall Bracket

OPN	Form Factor/ Dimensions	Data Transmission Rate	No. of Ports and Type	PCIe Interface	Secure Boot	Crypto	RoHS	Bracket Type
MCX623105AC-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/10/1 GbE	Single-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	✓	✓	✓	Tall Bracket
MCX623106AC-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/10/1 GbE	Dual-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	✓	✓	✓	Tall Bracket
MCX623105AE-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/10/1 GbE	Single-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	-	✓	✓	Tall Bracket
MCX623106AE-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/10/1 GbE	Dual-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	-	✓	✓	Tall Bracket
MCX623106AS-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/10/1 GbE	Dual-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	✓	-	✓	Tall Bracket

ConnectX-6 Dx 100GbE Adapter Cards for Timing and Telecommunication Application SMAs

OPN	Form Factor/ Dimensions	Data Transmission Rate	No. of Ports and Type	PCIe Interface	Secure Boot	Crypto	PPS In / Out SMAs	PPS OUT	PPS IN	SyncE & PTP GM Support	GNSS	RoHS	Bracket Type
MCX623106PN-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/10/1 GbE	Dual-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	-	-	✓	✓	✓	-	-	✓	Tall Bracket
MCX623106PC-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/10/1 GbE	Dual-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	✓	✓	✓	✓	✓	-	-	✓	Tall Bracket
MCX623106TN-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/10/1 GbE	Dual-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	-	-	✓	✓	✓	✓	-	✓	Tall Bracket

OPN	Form Factor/ Dimensions	Data Transmission Rate	No. of Ports and Type	PCIe Interface	Secure Boot	Crypto	PPS In / Out SMAs	PPS OUT	PPS IN	SyncE & PTP GM Support	GNSS	RoHS	Bracket Type
MCX623106TC-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/10/1 GbE	Dual-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	✓	✓	✓	✓	✓	✓	-	✓	Tall Bracket
MCX623106GN-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/10/1 GbE	Dual-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	-	-	✓	✓	-	✓	✓	✓	Tall Bracket
MCX623106GC-CDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	100/50/25/10/1 GbE	Dual-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	✓	✓	✓	✓	-	✓	✓	✓	Tall Bracket

ConnectX-6 Dx 200GbE Adapter Cards

OPN	Form Factor/ Dimensions	Data Transmission Rate	No. of Ports and Type	PCIe Interface	Secure Boot	Crypto	RoHS	Bracket Type
MCX623105AC-VDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	200/100/50/25/10/1 GbE	Single-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	✓	✓	✓	Tall Bracket
MCX623105AE-VDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	200/100/50/25/10/1 GbE	Single-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	-	✓	✓	Tall Bracket
MCX623105AN-VDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	200/100/50/25/10/1 GbE	Single-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	-	-	✓	Tall Bracket
MCX623105AS-VDAT	5.59in. x 2.71in (142.00mm x 68.90mm)	200/100/50/25/10/1 GbE	Single-port QSFP56	PCIe Gen 4.0 SERDES @ 16.0GT/s x16	✓	-	✓	Tall Bracket

For more detailed information see Specifications.

1.2 Features and Benefits

> ⚠ This section describes hardware features and capabilities. Please refer to the relevant driver and/or firmware release notes for feature availability.

Feature	Description
PCI Express (PCIe)	PCIe Gen 4.0 SERDES@ 8.0GT/s / 16.0GT/s through x8/x16 Edge Connector
Up to 200GbE	NVIDIA adapters comply with the following IEEE 802.3 standards: 200GbE / 100GbE / 50GbE / 40GbE / 25GbE / 10GbE / 1GbE - IEEE 802.3bj, 802.3bm 100 Gigabit Ethernet - IEEE 802.3by, Ethernet Consortium25, 50 Gigabit Ethernet, supporting all FEC modes - IEEE 802.3ba 40 Gigabit Ethernet - IEEE 802.3by 25 Gigabit Ethernet - IEEE 802.3ae 10 Gigabit Ethernet - IEEE 802.3ap based auto-negotiation and KR startup - IEEE 802.3ad, 802.1AX Link Aggregation - IEEE 802.1Q, 802.1P VLAN tags and priority - IEEE 802.1Qau (QCN) - Congestion Notification - IEEE 802.1Qaz (ETS) - IEEE 802.1Qbb (PFC) - IEEE 802.1Qbg - IEEE 1588v2 - Jumbo frame support (9.6KB)
Memory	• PCI Express - stores and accesses Ethernet fabric connection information and packet data. • SPI Quad - includes 256Mbit SPI Quad Flash device (MX25L25645GXDI-08G device by Macronix) • Available only in QSFP cards: FRU EEPROM - Stores the parameters and personality of the card. The EEPROM capacity is 128Kbit. FRU I2C address is (0x50) and is accessible through the PCIe SMBus (Note: Address 0x58 is reserved.)
Overlay Networks	In order to better scale their networks, data center operators often create overlay networks that carry traffic from individual virtual machines over logical tunnels in encapsulated formats such as NVGRE and VXLAN. While this solves network scalability issues, it hides the TCP packet from the hardware offloading engines, placing higher loads on the host CPU. ConnectX-6 Dx effectively addresses this by providing advanced NVGRE and VXLAN hardware offloading engines that encapsulate and de-capsulate the overlay protocol.
RDMA over Converged Ethernet (RoCE)	ConnectX-6 Dx, utilizing RoCE (RDMA over Converged Ethernet) technology, delivers low-latency and high-performance over Band and Ethernet networks. Leveraging data center bridging (DCB) capabilities, as well as ConnectX-6 Dx, advanced congestion control hardware mechanisms, RoCE provides efficient low-latency RDMA services over Layer 2 and Layer 3 networks.
NVIDIA PeerDirect®	NVIDIA PeerDirect® communication provides high-efficiency RDMA access by eliminating unnecessary internal data copies between components on the PCIe bus (for example, from GPU to CPU), and therefore significantly reduces application run time. ConnectX-6 Dx advanced acceleration technology enables higher cluster efficiency and scalability to tens of thousands of nodes.
CPU Offload	Adapter functionality enables reduced CPU overhead leaving more CPU resources available for computation tasks. Open vSwitch (OVS) offload using ASAP$^{2(TM)}$ • Flexible match-action flow tables • Tunneling encapsulation/decapsulation

Feature	Description
Quality of Service (QoS)	Support for port-based Quality of Service enabling various application requirements for latency and SLA.
Hardware-based I/O Virtualization	ConnectX-6 Dx provides dedicated adapter resources and guaranteed isolation and protection for virtual machines within the server.
Storage Acceleration	A consolidated compute and storage network achieves significant cost-performance advantages over multi-fabric networks. Standard block and file access protocols can leverage • RDMA for high-performance storage access • NVMe over Fabric offloads for the target machine
SR-IOV	ConnectX-6 Dx SR-IOV technology provides dedicated adapter resources and guaranteed isolation and protection for virtual machines (VM) within the server.
High-Performance Accelerations	• Tag Matching and Rendezvous Offloads • Adaptive Routing on Reliable Transport • Burst Buffer Offloads for Background Checkpointing
Time Sensitive Applications	NVIDIA offers a full IEEE 1588v2 PTP software solution, as well as time-sensitive related features called “5T”. NVIDIA PTP and 5T software solutions are designed to meet the most demanding PTP profiles. ConnectX-6 Dx incorporates an integrated Hardware Clock (PHC) that allows ConnectX-6 Dx to achieve sub 20u Sec accuracy and also offers many timing-related functions such as time-triggered scheduling or time-based SND accelerations (time-based ASAP^2). Furthermore, 5T technology enables the software application to transmit fronthaul (ORAN) compatible in high bandwidth. The PTP part supports the subordinate clock, master clock, and boundary clock. ConnectX-6 Dx PTP solution allows you to run any PTP stack on your host.
Enhanced-SyncE & PTP	NVIDIA offers ConnectX-6 Dx cards with SyncE support including an improved holdover to meet ITU-T G.8273.2 class C. Enabled in MCX623106TN-CDAT, MCX623106TC-CDAT, MCX623106GN-CDAT, and MCX623106GC-CDAT.
Grand Master (GNSS Reciver)	NVIDIA offers ConnectX-6 Dx with an integrated GNSS receiver to allow a compact and efficient solution for a Grand Master at every server. Enabled in MCX623106G[N/C]-CDAT
PPS In/Out SMAs	NVIDIA offers a full IEEE 1588v2 PTP software solution, as well as time-sensitive related features called “5T”. NVIDIA PTP and 5T software solutions are designed to meet the most demanding PTP profiles. ConnectX-6 Dx incorporates an integrated Hardware Clock (PHC) that allows ConnectX-6 Dx to achieve sub 20u Sec accuracy and also offers many timing-related functions such as time-triggered scheduling or time-based SND accelerations (time-based ASAP^2). Furthermore, 5T technology enables the software application to transmit fronthaul (ORAN) compatible in high bandwidth. The PTP part supports the subordinate clock, master clock, and boundary clock. ConnectX-6 Dx PTP solution allows you to run any PTP stack on your host. With respect to testing and measurements, selected NVIDIA adapters allow you to use the PPS-out signal from the onboard SMA connecter, ConnectX-6 Dx also allows measuring PTP in scale, with PPS-In signal. The PTP HW clock on the Network adapter will be sampled on each PPS-In signal, and the timestamp will be sent to the SW. Enabled in MCX623106PN-CDAT, MCX623106PC-CDAT, MCX623106TN-CDAT, MCX623106TC-CDAT, MCX623106GN-CDAT, and MCX623106GC-CDAT.

1.3 Operating Systems/Distributions

- RHEL/CentOS
- Windows
- FreeBSD
- VMware
- OpenFabrics Enterprise Distribution (MLNX_OFED)
- OpenFabrics Windows Distribution (WinOF-2)

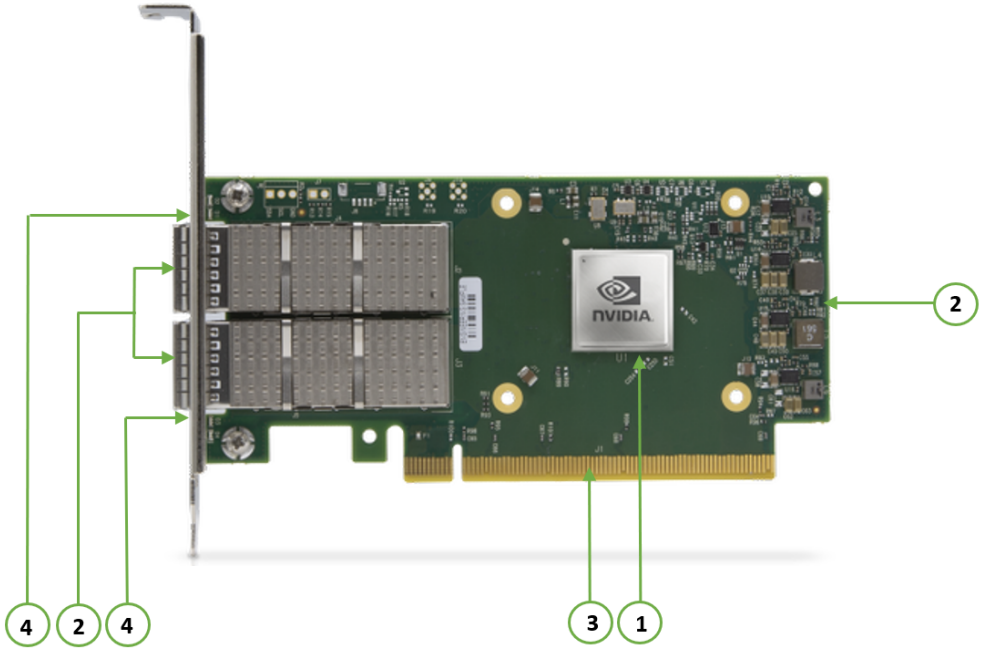
1.4 Connectivity

- Interoperable with 1/10/25/40/50/100/200 Gb/s Ethernet switches
- Passive copper cable with ESD protection
- Powered connectors for optical and active cable support

2 Interfaces

The below figures show the component side of the ConnectX-6 Dx adapter card. Each numbered interface that is referenced in the figures is described in the following table with a link to detailed information.

> ⚠ The below figures are for illustration purposes only and might not reflect the current revision of the adapter card.



Callout	Item	Description
1	“ConnectX-6 Dx IC”	ConnectX-6 Dx IC on the board.
2	“Ethernet SFP28/SFP56/QSFP56 Interface”	Ethernet traffic is transmitted through the adapter's SFP28/SFP56/QSFP56 connectors. The networking connectors allow for the use of modules, optical and passive cable interconnect solutions.
3	"PCI Express Interface"	PCIe Gen 3.0/4.0 through an x8/x16 edge connector.
4	“Networking Ports LEDs Interface”	There are two I/O LEDs per port to indicate speed and link status.
	“SMBus Interface”	Allows BMC connectivity using MCTP over SMBus or MCTP over PCIe protocols.
	“Voltage Regulators”	Voltage supply pins that feed onboard regulators.

2.1 ConnectX-6 Dx IC Interface

The ConnectX®-6 Dx EN family of adapter IC devices delivers two ports of 10/25/40/50/100Gb/s or a single-port of 200Gb/s Ethernet connectivity paired with best-in-class hardware capabilities that accelerate and secure cloud and data-center workloads.

2.1.1 Encryption

⚠ Applies to Crypto OPNs only.

ConnectX-6 Dx brings security to every end-point, including:

- Purpose-built inline acceleration engines that offload IPsec and TLS data-in-motion and XTS-AES data-at-rest cryptographic operations.
- Stateful firewall solution acceleration, powered by Open vSwitch connection tracking and NVIDIA's ASAP2 technology.
- Embedded hardware root-of-trust and support for RSA-based secure firmware update and secure boot, providing guaranteed integrity of the network adapter.

Ethernet SFP28 / SFP56 / QSFP56 Interfaces

The network ports of the ConnectX-6 Dx adapter card are compliant with the IEEE 802.3 Ethernet standards listed in Features and Benefits. Ethernet traffic is transmitted through the SFP28 / SFP56 / QSFP56 connector on the adapter card.

⚠ The adapter card includes special circuits to protect from ESD shocks to the card/server when plugging copper cables.

2.2 PCI Express Interface

ConnectX-6 Dx adapter cards support PCI Express Gen 3.0/4.0 (1.1 and 2.0 compatible) through x8/16 edge connectors. The device can be either a master initiating the PCI Express bus operations, or a slave responding to PCI bus operations.
The following lists PCIe interface features:

- PCIe Gen 4.0 and 3.0 compliant, 2.0 and 1.1 compatible
- 2.5, 5.0, 8.0, or 16.0 GT/s link rate x8 or x16 lanes
- Auto-negotiates to x16, x8, x4, x2, or x1
- Support for MSI/MSI-X mechanisms

2.3 Networking Ports LEDs Interface

For the networking ports LEDs description, follow the below table depending on the OPN you have purchased.

OPN	LEDs Scheme
MCX621102A[C/N/E]-ADAT, MCX621202A(C/S)-ADAT	Scheme 1: One Bi-Color LED
MCX623102A[C/N]-ADAT, MCX623102A[C/N]-GDAT, MCX623102A[S/E/N/C]-GDAT MCX623105A[N/E]-CDAT, MCX623106A[C/N/S/E]-CDAT, MCX623106P[C/N/E]-CDAT, MCX623105A[C/N/S/E]-VDAT	Scheme 2: One Bi-Color LED and one Single Color LED

2.3.1 Scheme 1: One Bi-Color LED

There is one bicolor (Yellow and Green) I/O LED per port to indicate speed and link status.

Link Indications

<table>
<tr><th>State</th><th>Bi-Color LED (Yellow/Green)
Physical link speed</th></tr>
<tr><td>Beacon command for locating the adapter card</td><td>1Hz blinking Yellow</td></tr>
<tr><td>Error</td><td>4Hz blinking Yellow Indicates an error with the link. The error can be one of the following:
<table>
<tr><th>Error Type</th><th>Description</th><th>LED Behavior</th></tr>
<tr><td>I^2C</td><td>I^2C access to the networking ports fails</td><td>Blinks until error is fixed</td></tr>
<tr><td>Over-current</td><td>Over-current condition of the networking ports</td><td>Blinks until error is fixed</td></tr>
</table></td></tr>
<tr><td>Physical Activity</td><td>The Green LED will blink.</td></tr>
<tr><td>Link Up</td><td>The Green LED will be solid.</td></tr>
</table>

2.3.2 Scheme 2: One Bi-Color LED and one Single Color LED

There are two I/O LEDs per port to indicate speed and link status. LED1 is a bicolor LED (Yellow and green) and LED2 is a single color LED (green).

Link Indications

State	Bi-Color LED (Yellow/Green)	Single Color LED (Green)
Beacon command for locating the adapter card	1Hz blinking Yellow	OFF

<table>
<tr><th>State</th><th>Bi-Color LED (Yellow/Green)</th><th>Single Color LED (Green)</th></tr>
<tr><td>Error</td><td>4Hz blinking Yellow Indicates an error with the link. The error can be one of the following:
<table>
<tr><th>Error Type</th><th>Description</th><th>LED Behavior</th></tr>
<tr><td>I²C</td><td>I²C access to the networking ports fails</td><td>Blinks until error is fixed</td></tr>
<tr><td>Over-current</td><td>Over-current condition of the networking ports</td><td>Blinks until error is fixed</td></tr>
</table></td><td>ON</td></tr>
<tr><td>Physical Activity</td><td>In full port speed: the Green LED is solid
In less than full port speed: the Yellow LED is solid</td><td>Blinking</td></tr>
<tr><td>Link Up</td><td>In full port speed: the Green LED is solid
In less than full port speed: the Yellow LED is solid</td><td>ON</td></tr>
</table>

SMBus Interface

ConnectX-6 Dx technology maintains support for manageability through a BMC. ConnectX-6 Dx PCIe stand-up adapter can be connected to a BMC using MCTP over SMBus or MCTP over PCIe protocols as if it is a standard NVIDIA PCIe stand-up adapter. For configuring the adapter for the specific manageability solution in use by the server, please contact NVIDIA Support.

2.4 Voltage Regulators

The voltage regulator power is derived from the PCI Express edge connector 12V supply pins. These voltage supply pins feed on-board regulators that provide the necessary power to the various components on the card.

3 Hardware Installation

Unknown macro: 'easy-heading-free'

Installation and initialization of ConnectX-6 Dx adapter cards require attention to the mechanical attributes, power specification, and precautions for electronic equipment.

3.0.1 Safety Warnings

Safety warnings are provided here in the English language. For safety warnings in other languages, refer to the Adapter Installation Safety Instructions.

Please observe all safety warnings to avoid injury and prevent damage to system components.

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3.0.2 Installation Procedure Overview

The installation procedure of ConnectX-6 Dx adapter cards involves the following steps:

Step	Procedure	Direct Link
1	Check the system's hardware and software requirements.	Refer to System Requirements
2	Pay attention to the airflow consideration within the host system	Refer to Airflow Requirements
3	Follow the safety precautions	Refer to Safety Precautions
4	Unpack the package	Refer to Unpack the package
5	Follow the pre-installation checklist	Refer to Pre-Installation Checklist
6	(Optional) Replace the full-height mounting bracket with the supplied short bracket	Refer to Bracket Replacement Instructions
7	Install the ConnectX-6 Dx card in the system	Refer to Installation Instructions
8	Connect cables or modules to the card	Refer to Cables and Modules
9	Identify ConnectX-6 Dx in the system	Refer to Identifying Your Card

3.0.3 System Requirements

3.0.3.1 Hardware Requirements

Unless otherwise specified, NVIDIA products are designed to work in an environmentally controlled data center with low levels of gaseous and dust (particulate) contamination.

The operation environment should meet severity level G1 as per ISA 71.04 for gaseous contamination and ISO 14644-1 class 8 for cleanliness level.

A system with a PCI Express slot of the corresponding bus width is required for installing the card.

For proper operation and performance, please make sure to use a PCIe slot with a corresponding bus width that can supply sufficient power to your card. Refer to the Specifications section of the manual for more power requirements.

3.0.3.2 Airflow Requirements

ConnectX-6 Dx adapter cards are offered with two airflow patterns: from the heatsink to the network ports.

Please refer to the Specifications section for airflow numbers for each specific card model.

All cards in the system should be planned with the same airflow direction.

3.0.3.3 Software Requirements

- See Operating Systems/Distributions section under the Introduction section.
- Software Stacks - NVIDIA OpenFabric software package MLNX_OFED for Linux, WinOF-2 for Windows, and VMware. See the Driver Installation section.

3.0.4 Safety Precautions

The adapter is being installed in a system that operates with voltages that can be lethal. Before opening the case of the system, observe the following precautions to avoid injury and prevent damage to system components.

- Remove any metallic objects from your hands and wrists.
- Make sure to use only insulated tools.
- Verify that the system is powered off and is unplugged.
- It is strongly recommended to use an ESD strap or other antistatic devices.

3.0.5 Unpacking the Package

Check against the package contents list that all the parts have been sent. Check the parts for visible damage that may have occurred during shipping. Please note that the cards must be placed on an antistatic surface.

Category	Qty.	Item
Cards	1	ConnectX-6 Dx adapter card
Accessories	1	Adapter card short bracket
	1	Adapter card tall bracket (shipped assembled on the card)

Please note that if the card is removed hastily from the antistatic bag, the plastic ziplock may harm the EMI fingers on the networking connector. Carefully remove the card from the antistatic bag to avoid damaging the EMI fingers.

3.0.6 Pre-Installation Checklist

1. Verify that your system meets the hardware and software requirements stated above.
2. Shut down your system if active.
   Turn off the power to the system, and disconnect the power cord. Refer to the system documentation for instructions.
3. (Optional) Check the mounting bracket on the card.
   If required for your system, replace the full-height mounting bracket that is shipped mounted on the card with the supplied low-profile bracket. Refer to Bracket Replacement Instructions.

3.0.7 Bracket Replacement Instructions

The ConnectX-6 Dx card is usually shipped with an assembled high-profile bracket. If this form factor is suitable for your requirements, you can skip the remainder of this section and move to Installation Instructions. If you need to replace the high-profile bracket with the short bracket that is included in the shipping box, please follow the instructions in this section.

Due to risk of damaging the EMI gasket, it is not recommended to replace the bracket more than three times.

To replace the bracket you will need the following parts:

- The new brackets of the proper height
- The 2 screws saved from the removal of the bracket

Removing the Existing Bracket

1. Using a torque driver, remove the two screws holding the bracket in place.
2. Separate the bracket from the ConnectX-6 Dx card.

   Be careful not to put stress on the LEDs on the adapter card.

3. Save the two screws.

Installing the New Bracket

1. Place the bracket onto the card until the screw holes line up.

   Do not force the bracket onto the adapter card.

2. Screw on the bracket using the screws saved from the bracket removal procedure above.

   Use a torque driver to apply up to 2 lbs-in torque on the screws.

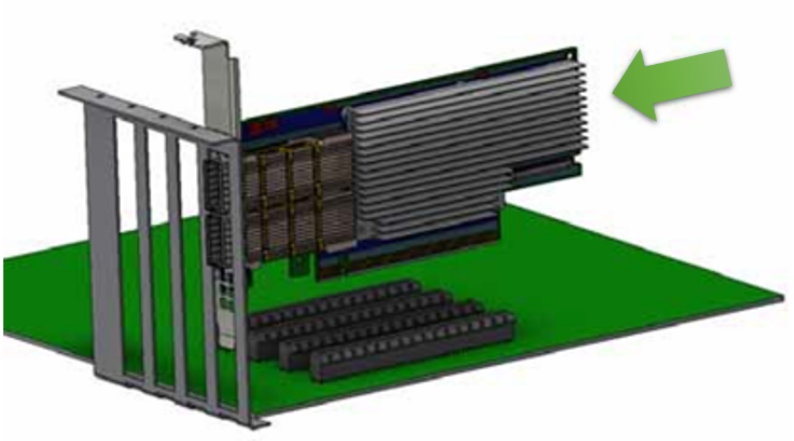
3.0.8 Installation Instructions

This section provides detailed instructions on how to install your adapter card in a system.

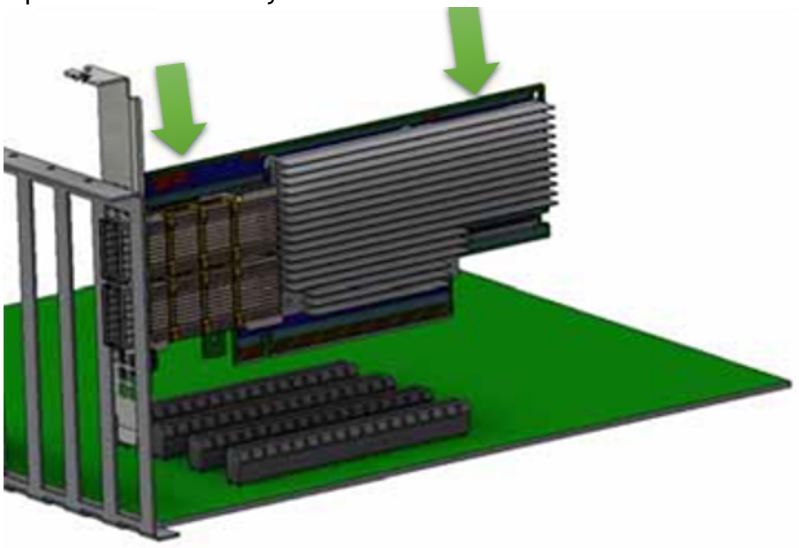
Please note that the following figures are for illustration purposes only.

➢ Connect the adapter Card in an available PCI Express slot in the chassis.

Step 1: Locate an available PCI Express slot and insert the adapter card to the chassis.



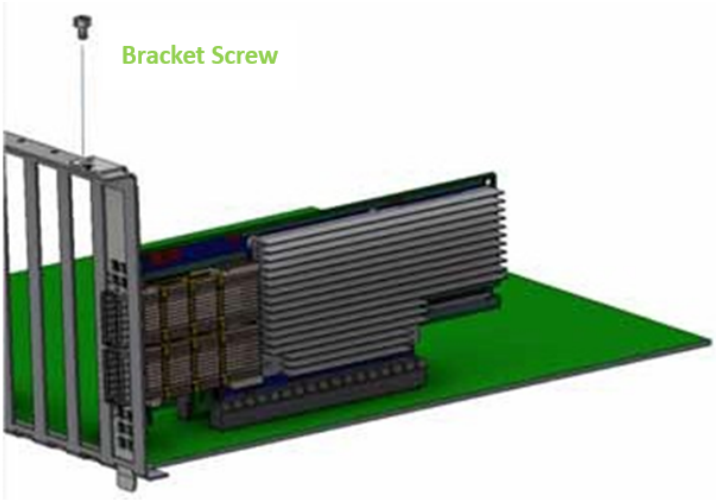
Step 2: Applying even pressure at both corners of the card, insert the adapter card in a PCI Express slot until firmly seated.



Do not use excessive force when seating the card, as this may damage the chassis.

➢ Secure the adapter card to the chassis.

Step 1: Secure the bracket to the chassis with the bracket screw.



To uninstall the adapter card, see Uninstalling the Card.

3.0.9 Cables and Modules

Cable Installation

1. All cables can be inserted or removed with the unit powered on.
2. To insert a cable, press the connector into the port receptacle until the connector is firmly seated.
    a. Support the weight of the cable before connecting the cable to the adapter card. Do this by using a cable holder or tying the cable to the rack.
    b. Determine the correct orientation of the connector to the card before inserting the connector. Do not try and insert the connector upside down. This may damage the adapter card.
    c. Insert the connector into the adapter card. Be careful to insert the connector straight into the cage. Do not apply any torque, up or down, to the connector cage in the adapter card.
    d. Make sure that the connector locks in place.
    When installing cables make sure that the latches engage.
    Always install and remove cables by pushing or pulling the cable and connector in a straight line with the card.
3. After inserting a cable into a port, the Green LED indicator will light when the physical connection is established (that is, when the unit is powered on and a cable is plugged into the port with the other end of the connector plugged into a functioning port). See LED Interface under the Interfaces section.
4. After plugging in a cable, lock the connector using the latching mechanism particular to the cable vendor. When data is being transferred the Green LED will blink. See LED Interface under the Interfaces section.
5. Care should be taken as not to impede the air exhaust flow through the ventilation holes. Use cable lengths that allow for routing horizontally around to the side of the chassis before bending upward or downward in the rack.
6. To remove a cable, disengage the locks and slowly pull the connector away from the port receptacle. The LED indicator will turn off when the cable is unseated.

3.0.10 Identifying the Card in Your System

On Linux

Get the device location on the PCI bus by running lspci and locating lines with the string “Mellanox Technologies”:

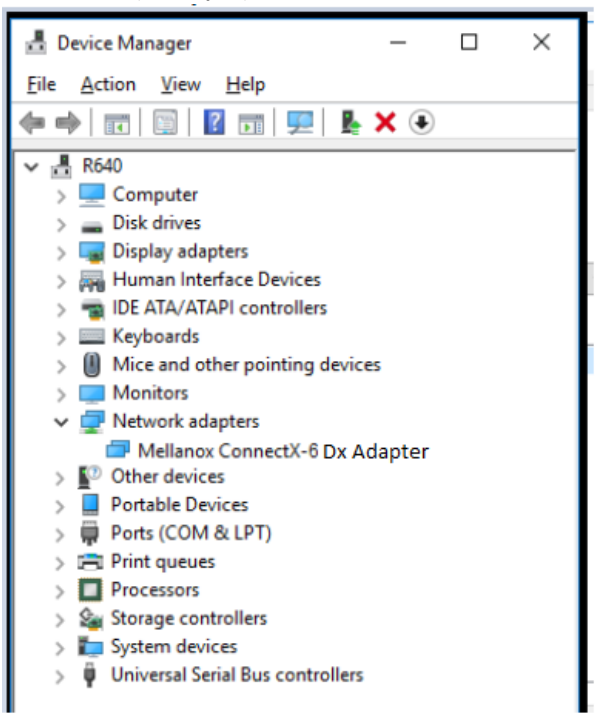
```
lspci |grep -i Mellanox
Network controller: Mellanox Technologies MT2892 Family [ConnectX-6 Dx]
```

On Windows

1. Open Device Manager on the server. Click Start => Run, and then enter devmgmt.msc.
2. Expand System Devices and locate your ConnectX-6 Dx adapter card.

3. Right click the mouse on your adapter's row and select Properties to display the adapter card properties window.
4. Click the Details tab and select Hardware Ids (Windows 2012/R2/2016) from the Property pull-down menu.

   PCI Device (Example)



5. In the Value display box, check the fields VEN and DEV (fields are separated by '&'). In the display example above, notice the sub-string "PCI\VEN_15B3&DEV_1003": VEN is equal to 0x15B3 – this is the Vendor ID of NVIDIA; and DEV is equal to 1018 (for ConnectX-6 Dx) – this is a valid NVIDIA PCI Device ID.

   > ⚠ If the PCI device does not have an NVIDIA adapter ID, return to Step 2 to check another device.

   > ⚠ The list of NVIDIA PCI Device IDs can be found at the PCI ID repository.

3.0.11 Uninstalling the Card

Safety Precautions

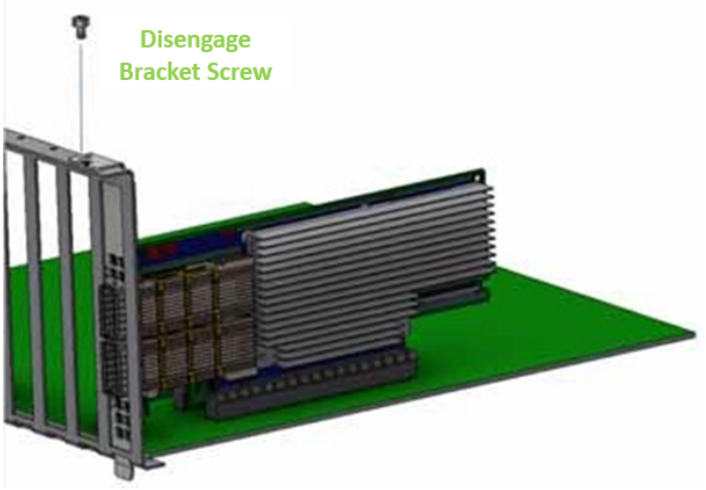
The adapter is installed in a system that operates with voltages that can be lethal. Before uninstalling the adapter card, please observe the following precautions to avoid injury and prevent damage to system components.

1. Remove any metallic objects from your hands and wrists.
2. It is strongly recommended to use an ESD strap or other antistatic devices.
3. Turn off the system and disconnect the power cord from the server.

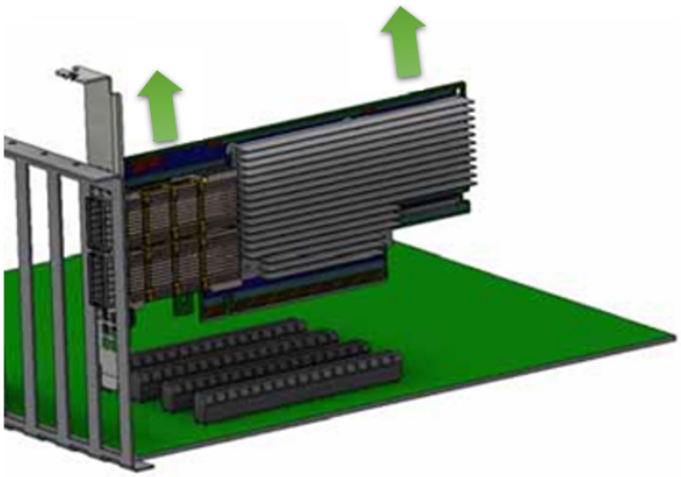
Card Removal

> Please note that the following images are for illustration purposes only.

1. Verify that the system is powered off and unplugged.
2. Wait 30 seconds.
3. To remove the card, disengage the retention mechanisms on the bracket (clips or screws).



4. Holding the adapter card from its center, gently pull the ConnectX-6 and Auxiliary Connections cards out of the PCI Express slot.



4 Driver Installation

Please use the relevant driver installation section.

- Linux Driver Installation
- Windows Driver Installation
- VMware Driver Installation

4.1 Linux Driver Installation

This section describes how to install and test the MLNX_OFED for Linux package on a single server with a ConnectX-6 Dx adapter card installed.

4.1.1 Prerequisites

Requirements	Description
Platforms	A server platform with a ConnectX-6 Dx Ethernet adapter card installed.
Required Disk Space for Installation	1GB
Operating System	Linux operating system. For the list of supported operating system distributions and kernels, please refer to the *MLNX_OFED Release Notes*.
Installer Privileges	The installation requires administrator (root) privileges on the target machine.

4.1.2 Downloading MLNX_OFED

1. Verify that the system has a network adapter installed by running lspci command. The below table provides output examples per ConnectX-6 Dx card configuration.

```
# lspci -v | grep Mellanox
86:00.0 Network controller [0207]: Mellanox Technologies MT28908A0 Family
Subsystem: Mellanox Technologies Device 0014
86:00.1 Network controller [0207]: Mellanox Technologies MT28908A0 Family
Subsystem: Mellanox Technologies Device 0014
```

For Linux driver installation, please refer to NVIDIA DOCA Installation Guide for Linux.

4.2 Windows Driver Installation

For Windows, download and install the latest WinOF-2 for Windows software package available via the NVIDIA website at: WinOF-2 webpage. Follow the installation instructions included in the download package (also available from the download page).

The snapshots in the following sections are presented for illustration purposes only. The installation interface may slightly vary, depending on the operating system in use.

4.2.1 Software Requirements

For the full list of supported operating systems, please refer to the WinOF-2 Documentation -> Release Notes.

4.2.2 Downloading WinOF-2 Driver

To download the .exe file according to your Operating System, please follow the steps below:

1. Obtain the machine architecture.
   a. To go to the Start menu, position your mouse in the bottom-right corner of the Remote Desktop of your screen.
   b. Open a CMD console (Click Task Manager-->File --> Run new task and enter CMD).
   c. Enter the following command.

   ```
   echo %PROCESSOR_ARCHITECTURE%
   ```

   On an x64 (64-bit) machine, the output will be “AMD64”.
2. Go to the WinOF-2 web page at: https://www.nvidia.com/en-us/networking/ > Products > Software > InfiniBand Drivers (Learn More) > Nvidia WinOF-2.
3. Download the .exe image according to the architecture of your machine (see Step 1).
   The name of the .exe is in the following format: MLNX_WinOF2-<version>_<arch>.exe.

   Installing the incorrect .exe file is prohibited. If you do so, an error message will be displayed.
   For example, if you install a 64-bit .exe on a 32-bit machine, the wizard will display the following (or a similar) error message: “The installation package is not supported by this processor type. Contact your vendor”

4.2.3 Installing WinOF-2 Driver

The snapshots in the following sections are for illustration purposes only. The installation interface may slightly vary, depending on the used operating system.

This section provides instructions for two types of installation procedures, and both require administrator privileges:

- Attended Installation
  An installation procedure that requires frequent user intervention.
- Unattended Installation
  An automated installation procedure that requires no user intervention.

4.2.3.1 Attended Installation

The following is an example of an installation session.

1. Double click the .exe and follow the GUI instructions to install MLNX_WinOF2.
2. [Optional] Manually configure your setup to contain the logs option (replace “LogFile” with the relevant directory).

   ```
   MLNX_WinOF2_<revision_version>_All_Arch.exe /v"/l*vx [LogFile]"
   ```

3. [Optional] If you do not want to upgrade your firmware version (i.e., MT_SKIPFWUPGRD default value is False).

   ```
   MLNX_WinOF2_<revision_version>_All_Arch.exe /v" MT_SKIPFWUPGRD=1"
   ```

4. [Optional] If you do not want to install the Rshim driver, run.

   ```
   MLNX_WinOF2_<revision_version>_All_Arch.exe /v" MT_DISABLE_RSHIM_INSTALL=1"
   ```

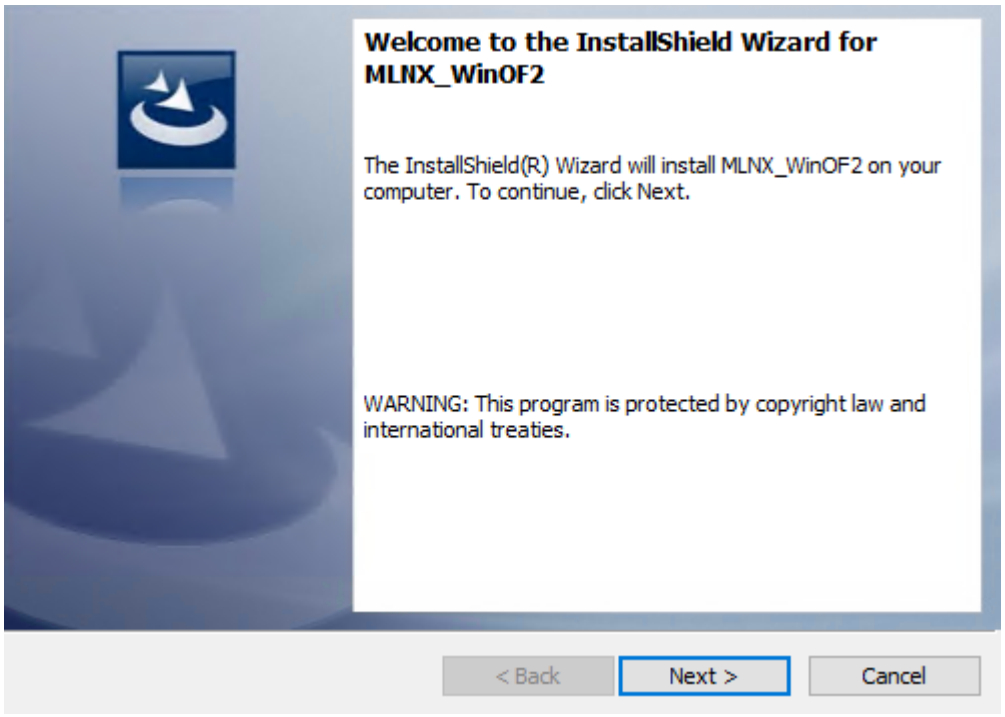
   The Rshim driver installanion will fail if a prior Rshim driver is already installed. The following fail message will be displayed in the log:

   "ERROR!!! Installation failed due to following errors: MlxRshim drivers installation disabled and MlxRshim drivers Installed, Please remove the following oem inf files from driver store: <oem inf list>"

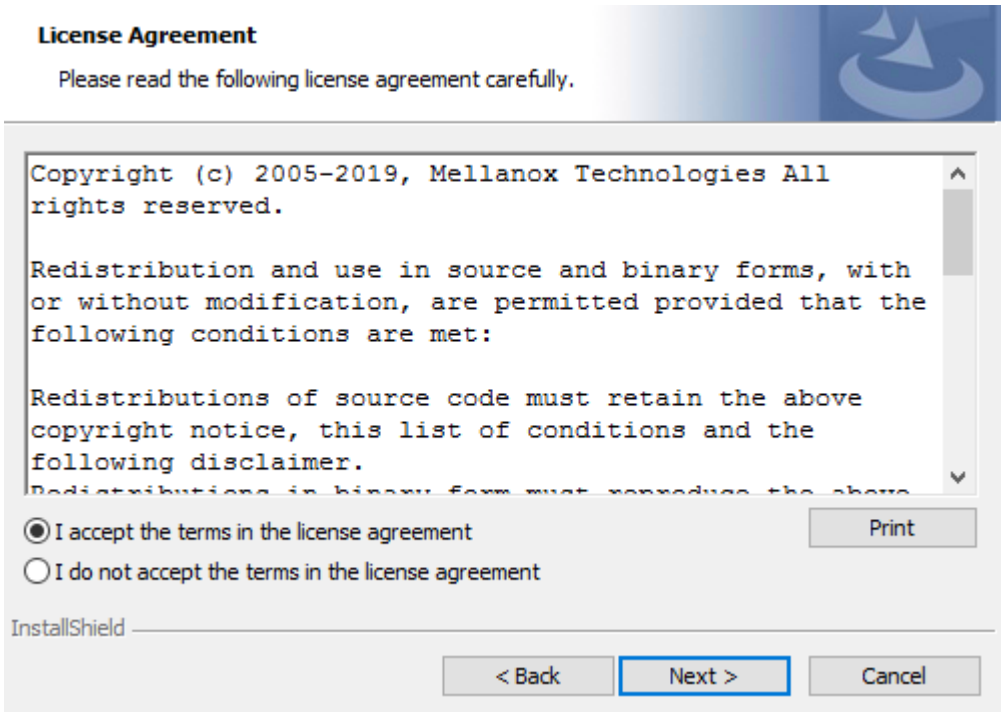
5. [Optional] If you want to skip the check for unsupported devices, run.

   ```
   MLNX_WinOF2_<revision_version>_All_Arch.exe /v" SKIPUNSUPPORTEDDEVCHECK=1"
   ```

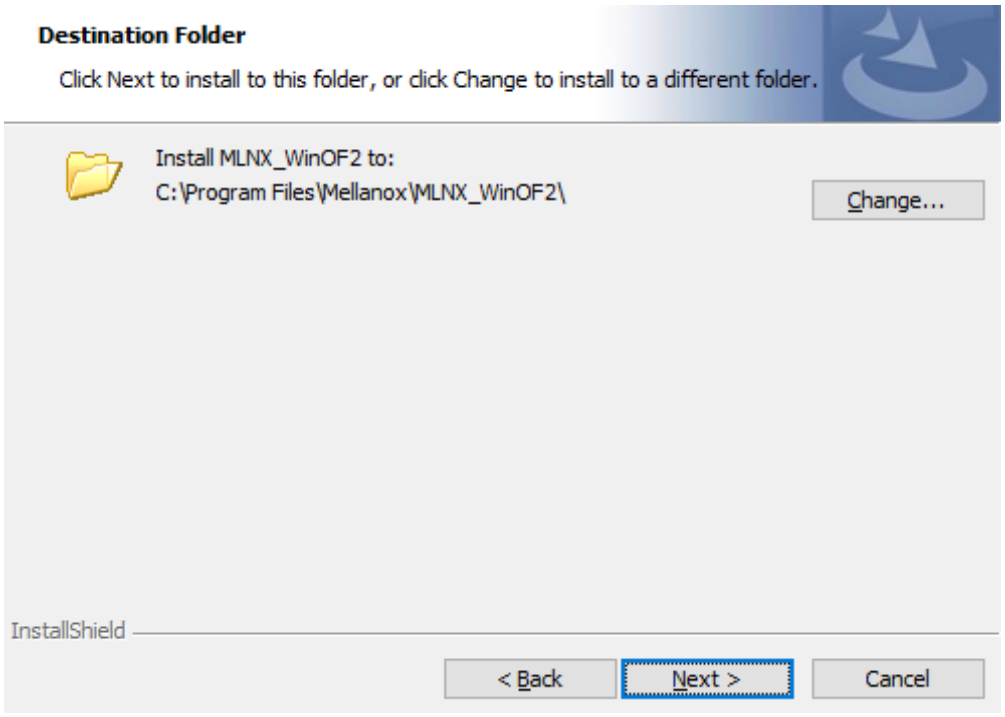
6. Click Next in the Welcome screen.



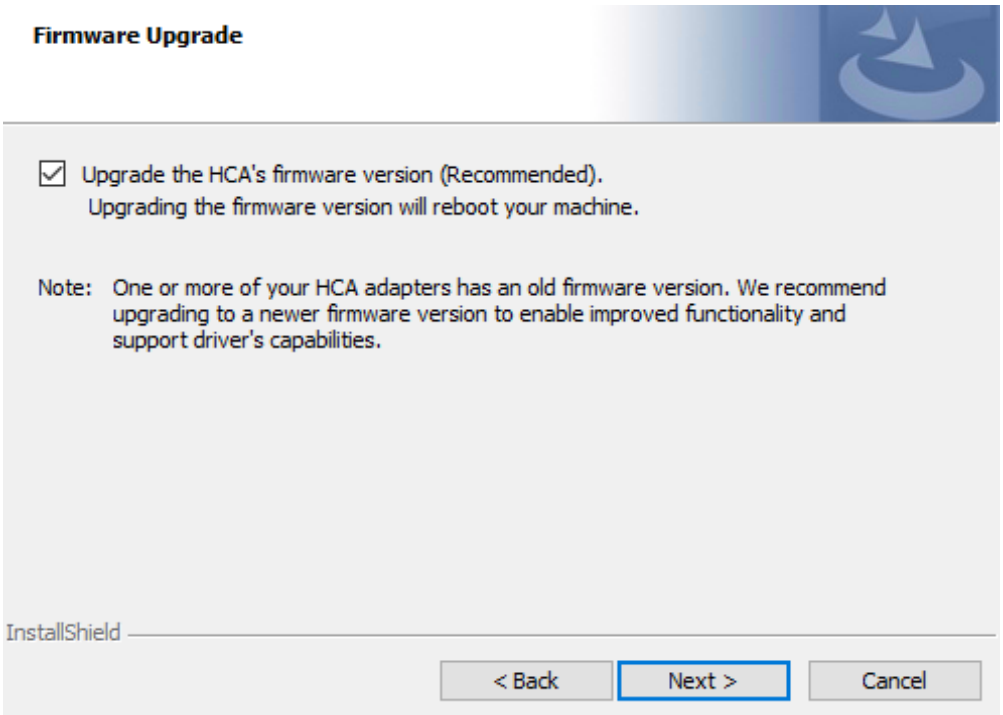
7. Read and accept the license agreement and click Next.



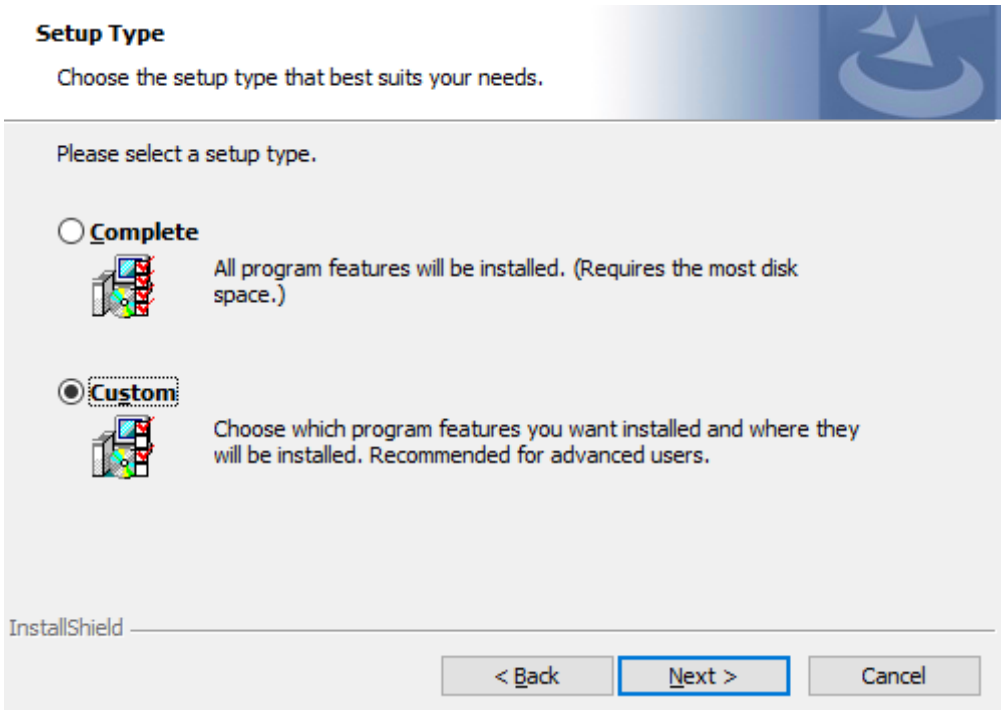
8. Select the target folder for the installation.



9. The firmware upgrade screen will be displayed in the following cases:
    - If the user has an OEM card. In this case, the firmware will not be displayed.
    - If the user has a standard NVIDIA® card with an older firmware version, the firmware will be updated accordingly. However, if the user has both an OEM card and a NVIDIA® card, only the NVIDIA® card will be updated.

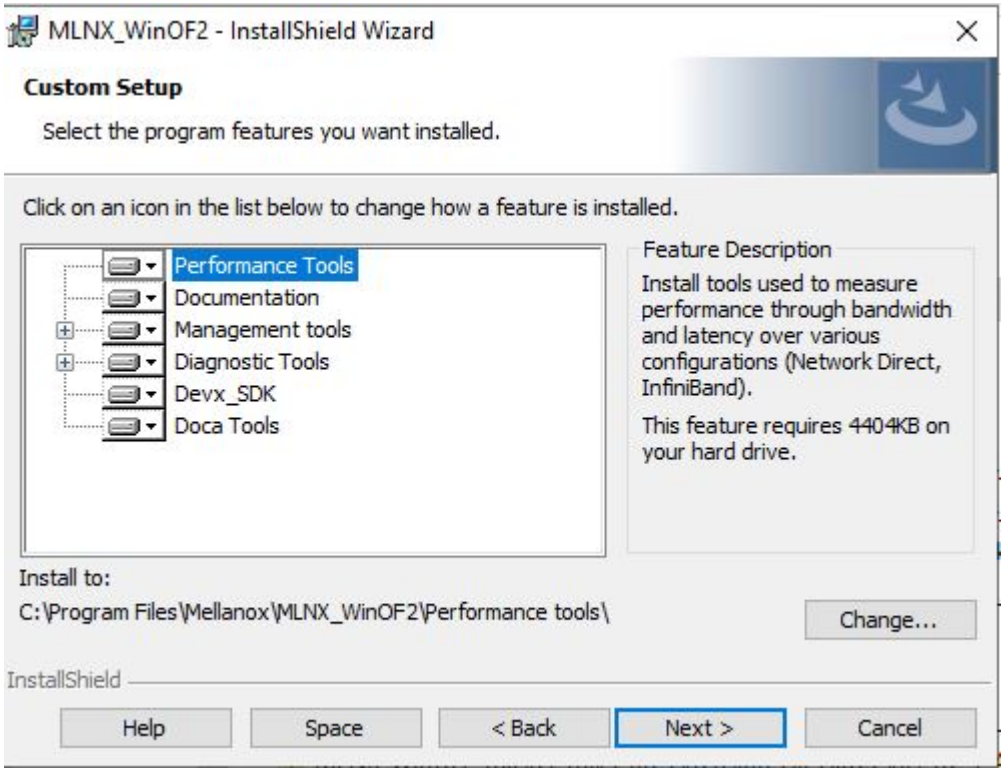


10. Select a Complete or Custom installation, follow Step a onward.

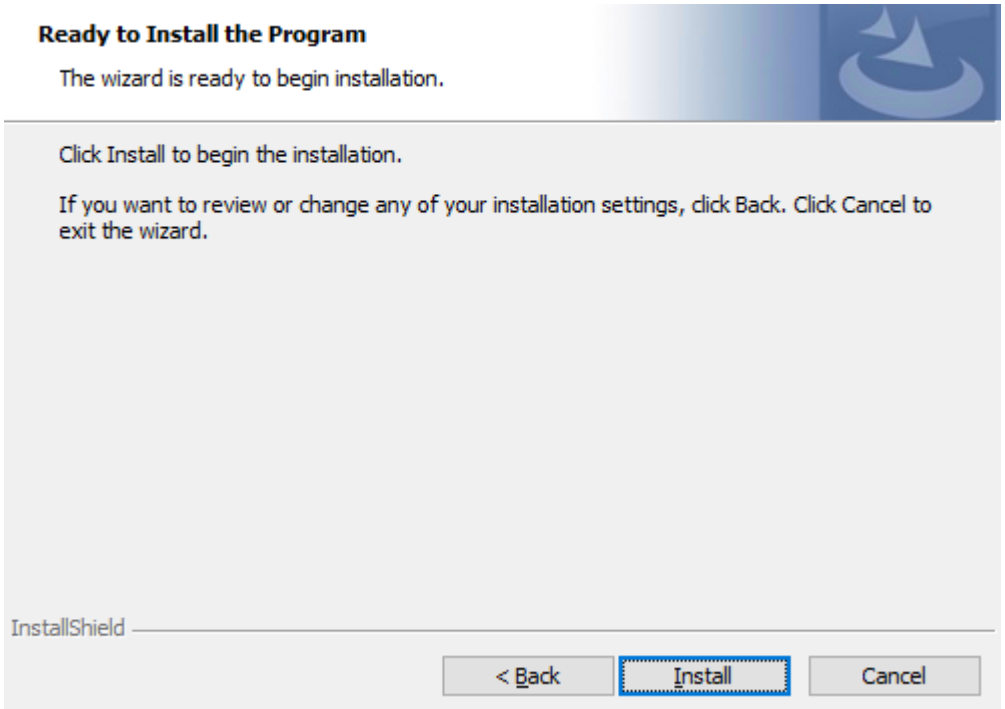


a. Select the desired feature to install:
   - Performances tools - install the performance tools that are used to measure performance in user environment
   - Documentation - contains the User Manual and Release Notes
   - Management tools - installation tools used for management, such as mlxstat
   - Diagnostic Tools - installation tools used for diagnostics, such as mlx5cmd

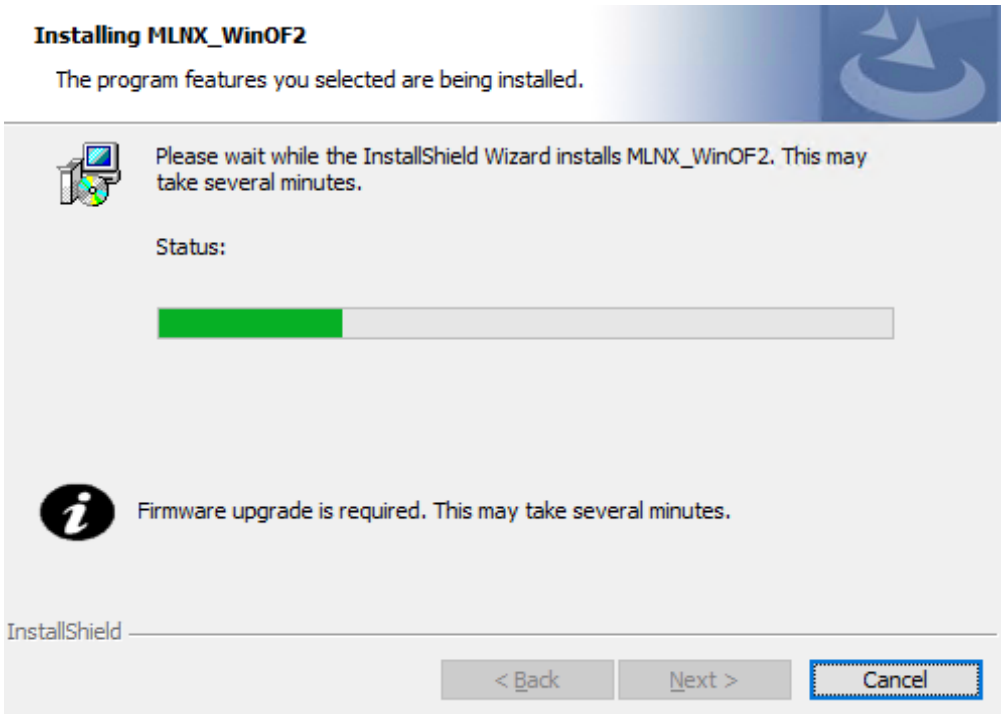
b. Click Next to install the desired tools.



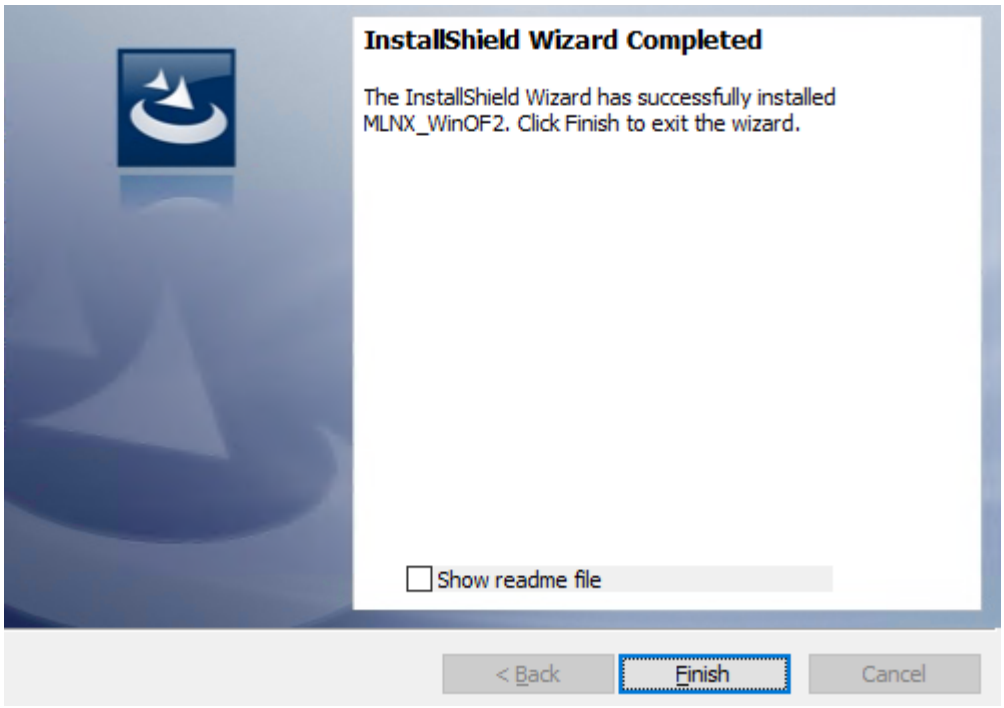
11. Click Install to start the installation.



12. In case firmware upgrade option was checked in Step 7, you will be notified if a firmware upgrade is required (see).



13. Click Finish to complete the installation.



4.2.3.2 Unattended Installation

> If no reboot options are specified, the installer restarts the computer whenever necessary without displaying any prompt or warning to the user.
> To control the reboots, use the */norestart* or */forcerestart* standard command-line options.

The following is an example of an unattended installation session.

1. Open a CMD console-> Click Start-> Task Manager File-> Run new task-> and enter CMD.
2. Install the driver. Run:

```
MLNX_WinOF2-[Driver/Version]_<revision_version>_All_-Arch.exe /S /v/qn
```

3. [Optional] Manually configure your setup to contain the logs option:

```
MLNX_WinOF2-[Driver/Version]_<revision_version>_All_-Arch.exe /S /v/qn /v"/l*vx [LogFile]"
```

4. [Optional] if you wish to control whether to install ND provider or not (i.e., *MT_NDPROPERTY default value is True*).

```
MLNX_WinOF2-[Driver/Version]_<revision_version>_All_Arch.exe /vMT_NDPROPERTY=1
```

5. [Optional] If you do not wish to upgrade your firmware version (i.e.,*MT_SKIPFWUPGRD default value is False*).

```
MLNX_WinOF2-[Driver/Version]_<revision_version>_All_Arch.exe /vMT_SKIPFWUPGRD=1
```

6. [Optional] If you do not want to install the Rshim driver, run.

```
MLNX_WinOF2_<revision_version>_All_Arch.exe /v" MT_DISABLE_RSHIM_INSTALL=1"
```

> The Rshim driver installanion will fail if a prior Rshim driver is already installed. The following fail message will be displayed in the log:
>
> "ERROR!!! Installation failed due to following errors: MlxRshim drivers installation disabled and MlxRshim drivers Installed, Please remove the following oem inf files from driver store: <oem inf list>"

7. [Optional] If you want to enable the default configuration for Rivermax, run.

```
MLNX_WinOF2_<revision_version>_All_Arch.exe /v"MT_RIVERMAX=1 /l*vx C:\Users\<user>\log.txt "
```

8. [Optional] If you want to skip the check for unsupported devices, run/

```
MLNX_WinOF2_<revision_version>_All_Arch.exe /v" SKIPUNSUPPORTEDDEVCHECK=1"
```

4.2.4 Firmware Upgrade

If the machine has a standard NVIDIA® card with an older firmware version, the firmware will be automatically updated as part of the NVIDIA® WinOF-2 package installation. For information on how to upgrade firmware manually, please refer to MFT User Manual.

If the machine has a DDA (pass through) facility, firmware update is supported only in the Host. Therefore, to update the firmware, the following must be performed:

1. Return the network adapters to the Host.
2. Update the firmware according to the steps in the MFT User Manual.
3. Attach the adapters back to VM with the DDA tools.

4.3 VMware Driver Installation

This section describes VMware Driver Installation.

4.3.1 Hardware and Software Requirements

Requirement	Description
Platforms	A server platform with an adapter card based on NVIDIA devices: • ConnectX®-6 Dx (EN) (firmware: fw-ConnectX6Dx)
Operating System	ESXi 8.x
Installer Privileges	The installation requires administrator privileges on the target machine.

4.3.2 Installing NATIVE ESXi Driver for VMware vSphere

⚠ Please uninstall all previous driver packages prior to installing the new version.

To install the driver:

1. Log into the ESXi server with root permissions.
2. Install the driver.

   ```
   #> esxcli software vib install -d <path>/<bundle_file>
   ```

   Example:

   ```
   #> esxcli software vib install -d /tmp/MLNX-NATIVE-ESX-ConnectX-4-5_4.16.8.8-10EM-650.0.0.4240417.zipesxcli
   ```

3. Reboot the machine.
4. Verify the driver was installed successfully.

   ```
   esxcli software vib list | grep nmlx
   nmlx5-core      4.16.8.8-1OEM.650.0.0.4240417    MEL    PartnerSupported 2017-01-31
   ```

```
nmlx5-rdma      4.16.8.8-1OEM.650.0.0.4240417    MEL     PartnerSupported 2017-01-31
```

⚠ After the installation process, all kernel modules are loaded automatically upon boot.

4.3.3 Removing Earlier NVIDIA Drivers

⚠ Please unload the previously installed drivers before removing them.

To remove all the drivers:

1. Log into the ESXi server with root permissions.
2. List all the existing NATIVE ESXi driver modules. (See Step 4 in Installing NATIVE ESXi Driver for VMware vSphere.)
3. Remove each module:

```
#> esxcli software vib remove -n nmlx5-rdma
#> esxcli software vib remove -n nmlx5-core
```

⚠ To remove the modules, you must run the command in the same order as shown in the example above.

4. Reboot the server.

4.3.4 Firmware Programming

1. Download the VMware bootable binary images v4.6.0 from the Firmware Tools (MFT) site.
   a. ESXi 6.5 File: mft-4.6.0.48-10EM-650.0.0.4598673.x86_64.vib
   b. MD5SUM: 0804cffe30913a7b4017445a0f0adbe1
2. Install the image according to the steps described in the MFT User Manual.

⚠ The following procedure requires custom boot image downloading, mounting and booting from a USB device.

5 Updating Adapter Firmware

Each adapter card is shipped with the latest version of qualified firmware at the time of manufacturing. However, NVIDIA issues firmware updates occasionally that provide new features and bug fixes. To check that your card is programmed with the latest available firmware version, download the mlxup firmware update and query utility. The utility can query for available NVIDIA adapters and indicate which adapters require a firmware update. If the user confirms, mlxup upgrades the firmware using embedded images. The latest mlxup executable and documentation are available in mlxup - Update and Query Utility.

```
[server1]# ./mlxup
Querying Mellanox devices firmware ...
Device Type:      ConnectX-6 Dx
Part Number:      MCX623105AN-VDAT
Description:      ConnectX®-6 Dx EN adapter card, 200GbE , Single-port QSFP56, PCIe 4.0 x16, No Crypto, Tall Bracket
PSID:             MT_2190110032
PCI Device Name: 0000:06:00.0
Base GUID:        e41d2d0300fd8b8a
Versions:         Current            Available
                  FW 16.23.1020      16.24.1000

Status:           Update required

Device Type:      ConnectX-6 Dx
Part Number:      MCX623105AN-VDAT
Description:      ConnectX®-6 Dx EN adapter card, 200GbE , Single-port QSFP56, PCIe 4.0 x16, No Crypto, Tall Bracket
PSID:             MT_2170110021
PCI Device Name: 0000:07:00.0
Base MAC:         0000e41d2da206d4
Versions:         Current          Available
                  FW 16.24.1000    16.24.1000

Status:           Up to date

Perform FW update? [y/N]: y
Device #1: Up to date
Device #2: Updating FW ... Done

Restart needed for updates to take effect.
Log File: /var/log/mlxup/mlxup-yyyymmdd.log
```

6 Troubleshooting

6.1 General Troubleshooting

Server unable to find the adapter	• Ensure that the adapter is placed correctly • Make sure the adapter slot and the adapter are compatible Install the adapter in a different PCI Express slot • Use the drivers that came with the adapter or download the latest • Make sure your motherboard has the latest BIOS • Try to reboot the server
The adapter no longer works	• Reseat the adapter in its slot or a different slot, if necessary • Try using another cable • Reinstall the drivers for the network driver files may be damaged or deleted • Reboot the server
Adapters stopped working after installing another adapter	• Try removing and re-installing all adapters • Check that cables are connected properly • Make sure your motherboard has the latest BIOS
Link indicator light is off	• Try another port on the switch • Make sure the cable is securely attached • Check you are using the proper cables that do not exceed the recommended lengths • Verify that your switch and adapter port are compatible
Link light is on, but with no communication established	• Check that the latest driver is loaded • Check that both the adapter and its link are set to the same speed and duplex settings
Event message received of insufficient power	• When [adapter's current power consumption] > [PCIe slot advertised power limit] - a warning message appears in the server's system even logs (Eg. dmesg: "Detected insufficient power on the PCIe slow") • It's recommended to use a PCIe slot that can supply enough power. • If a message of the following format appears - "mlx5_core 0003:01:00.0: port_module:254:(pid 0): Port module event[error]: module 0, Cable error, One or more network ports have been powered down due to insufficient/ unadvertised power on the PCIe slot" please upgrade your Adapter's firmware. • If the message remains - please consider switching from Active Optical Cable (AOC) or transceiver to Direct Attached Copper (DAC) connectivity.

6.2 Linux Troubleshooting

Environment Information	cat /etc/issue uname -a cat /proc/cupinfo | grep 'model name' | uniq ofed_info -s ifconfig -a ip link show ethtool <interface> ethtool -i <interface_of_Mellanox_port_num> ibdev2netdev
Card Detection	lspci | grep -i Mellanox
Mellanox Firmware Tool (MFT)	Download and install MFT: MFT Documentation Refer to the User Manual for installation instructions. Once installed, run: mst start mst status flint -d <mst_device> q
Ports Information	ibstat ibv_devinfo
Firmware Version Upgrade	To download the latest firmware version, refer to the NVIDIA Update and Query Utility.
Collect Log File	cat /var/log/messages dmesg >> system.log journalctl (Applicable on new operating systems) cat /var/log/syslog

6.3 Windows Troubleshooting

Environment Information	From the Windows desktop choose the Start menu and run: `msinfo32` To export system information to a text file, choose the Export option from the File menu. Assign a file name and save.
Mellanox Firmware Tool (MFT)	Download and install MFT: MFT Documentation Refer to the User Manual for installation instructions. Once installed, open a CMD window and run: WinMFT mst start mst status flint -d <mst_device> q
Ports Information	vstat
Firmware Version Upgrade	Download the latest firmware version using the PSID/board ID from here. flint -d <mst_device> -i <firmware_bin_file> b

Collect Log File	• Event log viewer
	• MST device logs:
	  • mst start
	  • mst status
	• flint –d <mst_device> dc > dump_configuration.log
	• mstdump <mst_device> dc > mstdump.log

7 Specifications

> Power numbers are provided for passive cables only. For board power numbers while using active cables, please add the outcome of the following formula to the passive cables power numbers stated below:
> *Active_Module_Power* x *Number_of_Modules* x 1.1 (efficiency factor)

7.1 MCX621102AC-ADAT / MCX621102AN-ADAT Specifications

> These products have reached the end-of-life milestone.

<table>
<tr><td>Capabilities</td><td colspan="4">• MCX621102AC-ADAT: Crypto enabled, Secure Boot enabled
• MCX621102AN-ADAT:Crypto disabled, Secure Boot disabled</td></tr>
<tr><td rowspan="2">Physical</td><td colspan="4">Size: 4.89in. x 2.71in (124.22mm x 68.90mm)</td></tr>
<tr><td colspan="4">Connector: Dual SFP28 Ethernet (copper and optical)</td></tr>
<tr><td rowspan="3">Protocol Support</td><td>Data Rate:</td><td>Ethernet</td><td colspan="2">1/10/25 Gb/s</td></tr>
<tr><td colspan="4">Ethernet: 25GBASE-R, 20GBASE-KR2, 10GBASE-LR,10GBASE-ER, 10GBASE-CX4, 10GBASE-CR, 10GBASE-KR, SGMII, 1000BASE-CX, 1000BASE-KX, 10GBASE-SR</td></tr>
<tr><td colspan="4">PCI Express Gen 3.0/4.0: SERDES @ 16.0GT/s, 8 lanes (2.0 and 1.1 compatible)</td></tr>
<tr><td rowspan="9">Power and Airflow Specifications[a]</td><td colspan="4">Voltage: 3.3Aux
Maximum current: 100mA</td></tr>
<tr><td>Power</td><td>Cable</td><td>PCIe Gen 3.0</td><td>PCIe Gen 4.0</td></tr>
<tr><td>Typical Power</td><td>Passive Cables</td><td>10.88 W</td><td>11.29W</td></tr>
<tr><td>Maximum Power</td><td>Passive Cables</td><td>15.55 W</td><td>15.96W</td></tr>
<tr><td colspan="4">Maximum power available through SFP28 port: 1.5W (per port)</td></tr>
<tr><td rowspan="4">Airflow @ 55C[b]</td><td>Cable Type</td><td colspan="2">Hot Aisle - Heatsink to Port</td></tr>
<tr><td>Passive Cable</td><td colspan="2">200LFM</td></tr>
<tr><td>Active 0.8W Cable</td><td colspan="2">400 LFM</td></tr>
<tr><td>Active 1.5W Cable</td><td colspan="2">450LFM</td></tr>
<tr><td rowspan="5">Environmental</td><td rowspan="2">Temperature</td><td>Operational</td><td colspan="2">0°C to 55°C</td></tr>
<tr><td>Non-operational</td><td colspan="2">-40°C to 70°C[c]</td></tr>
<tr><td rowspan="2">Humidity</td><td>Operational</td><td colspan="2">10% to 85% relative humidity</td></tr>
<tr><td>Non-operational</td><td colspan="2">10% to 90% relative humidity</td></tr>
<tr><td>Altitude (Operational)</td><td colspan="3">3050m</td></tr>
</table>

Regulatory	**Safety**	CB / cTUVus / CE
	EMC	CE / FCC / VCCI / ICES / RCM
	RoHS	RoHS compliant

a. Typical power for ATIS traffic load.
b. Airflow is measured in wind tunnel. Contact NVIDIA for airflow numbers with other active modules' power levels.
c. The non-operational storage temperature specifications apply to the product without its package.

7.2 MCX623102AC-ADAT / MCX623102AN-ADAT / MCX623102AS-ADAT Specifications

ⓘ These products have reached the end-of-life milestone.

Capabilities	• **MCX623102AC-ADAT:** Crypto enabled, Secure Boot enabled • **MCX623102AN-ADAT:** Crypto disabled, Secure Boot disabled • **MCX623102AS-ADAT:** Crypto disabled, Secure Boot enabled			
Physical	**Size**: 5.59in. x 2.71in (142.00mm x 68.90mm)			
	Connector: Dual SFP28 Ethernet (copper and optical)			
Protocol Support	**Data Rate**:	Ethernet	1/10/25 Gb/s	
	Ethernet: 25GBASE-R, 20GBASE-KR2, 10GBASE-LR,10GBASE-ER, 10GBASE-CX4, 10GBASE-CR, 10GBASE-KR, SGMII, 1000BASE-CX, 1000BASE-KX, 10GBASE-SR			
	PCI Express Gen 3.0/4.0: SERDES @ 16.0GT/s, 16 lanes (2.0 and 1.1 compatible)			
Power and Airflow [a]	**Voltage:** 3.3Aux **Maximum current:** 100mA			
	Power	**Cable Type**	**PCIe Gen 3.0**	**PCIe Gen 4.0**
	Typical Power	Passive Cables	14.87W	15.68W
	Maximum Power	Passive Cables	18.92W	19.74W
	Maximum power available through SFP28 port: 2.5W (each port)			
	Airflow @ 55C[b]	**Cable Type**	**Hot Aisle - Heatsink to Port**	
		Passive Cable	300LFM	
		Active 0.8 Cable	400LFM	
		Active 2.5W Cable	500LFM	
Environmental	**Temperature**	Operational	0°C to 55°C	
		Non-operational	-40°C to 70°C[c]	
	Humidity	Operational	10% to 85% relative humidity	
		Non-operational	10% to 90% relative humidity	
	Altitude (Operational)	3050m		
Regulatory	**Safety**	CB / cTUVus / CE		
	EMC	CE / FCC / VCCI / ICES / RCM		

	RoHS	RoHS compliant

a. Typical power for ATIS traffic load.
b. Airflow is measured in wind tunnel. Contact NVIDIA for airflow numbers with other active modules' power levels.
c. The non-operational storage temperature specifications apply to the product without its package.

7.3 MCX621202AS-ADAT / MCX621202AC-ADAT Specifications

⚠ These cards are optimized for Workstation Environments and include an onboard cooling fan that meets the acoustic requirement for workstations.

- At Idle 20 dBA max
- TDP Room 34 dBA Max
- TDP Max 47 dBA Max

Fan speed is controlled automatically depending on board load.

Capabilities	• **MCX621202AS-ADAT:** Crypto disabled, Secure Boot enabled • **MCX621202AC-ADAT:** Crypto enabled, Secure Boot enabled			
Physical	**Size**: 6.01in. x 2.71in (152.9mmx 68.9 mm)			
	Connector: Dual SFP28 Ethernet (copper and optical)			
Protocol Support	**Data Rate**:	Ethernet	1/10/25 Gb/s	
	Ethernet: 25GBASE-R, 20GBASE-KR2, 10GBASE-LR,10GBASE-ER, 10GBASE-CX4, 10GBASE-CR, 10GBASE-KR, SGMII, 1000BASE-CX, 1000BASE-KX, 10GBASE-SR			
	PCI Express Gen 3.0/4.0: SERDES @ 16.0GT/s, 8 lanes (2.0 and 1.1 compatible)			
Capabilities	MCX621202AS-ADAT: Crypto Disabled, Secure Boot Enabled MCX621202AC-ADAT: Crypto Enabled[a], Secure Boot Enabled			
Power Specifications[a]	**Voltage:** 3.3Aux **Maximum current:** 100mA			
	Power	**Cable Type**	**PCIe Gen 3.0**	**PCIe Gen 4.0**
	Typical Power	Passive Cables	9.6W	9.9W
	Maximum Power	Passive Cables	13.7W	14W
	Maximum power available through SFP28 port: 2.5W (each port)			
Maximum Allowed Inlet Temperature[b]	**External Airflow Conditions**	**Cable Type**	**Maximum Allowed Fan Inlet Temperature**	
	No External Airflow	Passive Copper Module	50°	
		NVIDIA SFP28 0.8W Module	40°	
		10G Base SFP-10G-T-NC 2.5W Cable	40°	

	150LFM External Airflow (Airflow Direction: Heatsink to Port)	Passive Copper Module	55°
		NVIDIA SFP28 0.8W Module	50°
		10G Base SFP-10G-T-NC 2.5W Cable	50°
Environmental	**Temperature**	Operational	0°C to 55°C
		Non-operational	-40°C to 70°C[c]
	Humidity	Operational	10% to 85% relative humidity
		Non-operational	10% to 90% relative humidity
	Altitude (Operational)	3050m	
Regulatory	**Safety**	CB / cTUVus / CE	
	EMC	CE / FCC / VCCI / ICES / RCM	
	RoHS	RoHS compliant	

a. If your target application for this crypto-enabled card will utilize 100Gb/s or higher bandwidth, where a substantial part of the bandwidth will be allocated for IPsec traffic, please refer to the NVIDIA ConnectX-6 Dx Product Release Notes document to learn about a potential bandwidth limitation. See Related Documents section for details on accessing the document.
b. Typical power for ATIS traffic load.
c. Airflow is measured in wind tunnel. Contact NVIDIA for airflow numbers with other active modules' power levels.

7.4 MCX623102AC-GDAT / MCX623102AE-GDAT / MCX623102AN-GDAT / MCX623102AS-GDAT Specifications

These products have reached the end-of-life milestone.

Capabilities	• **MCX623102AC-GDAT:** Crypto enabled, Secure Boot enabled • **MCX623102AE-GDAT:** Crypto disabled, Secure Boot disabled • **MCX623102AN-GDAT:** Crypto disabled, Secure Boot disabled • **MCX623102AS-GDAT:** Crypto disabled, Secure Boot enabled		
Physical	**Size**: 5.59in. x 2.71in (142.00mm x 68.90mm)		
	Connector: Dual SFP56 Ethernet (copper and optical)		
Protocol Support	**Data Rate**:	Ethernet	1/10/25/40/50 Gb/s
	Ethernet: 50GBASE-R2, 50GBASE-R4, 40GBASE-CR4, 40GBASE-KR4, 40GBASE-SR4, 40GBASE-LR4, 40GBASE-ER4, 40GBASE-R2, 25GBASE-R, 20GBASE-KR2, 10GBASE-LR,10GBASE-ER, 10GBASE-CX4, 10GBASE-CR, 10GBASE-KR, SGMII, 1000BASE-CX, 1000BASE-KX, 10GBASE-SR		
	PCI Express Gen 3.0/4.0: SERDES @ 16.0GT/s, 16 lanes (2.0 and 1.1 compatible)		

<table>
<tr><td rowspan="7">Power and Airflow [a]</td><td colspan="4">Voltage: 3.3Aux
Maximum current: 100mA</td></tr>
<tr><td>Power</td><td>Cable Type</td><td>PCIe Gen 3.0</td><td>PCIe Gen 4.0</td></tr>
<tr><td>Typical Power</td><td>Passive Cables</td><td>14.94W</td><td>15.76W</td></tr>
<tr><td>Maximum Power</td><td>Passive Cables</td><td>20.16W</td><td>20.98W</td></tr>
<tr><td colspan="4">Maximum power available through SFP56 port: 2.5W (each port)</td></tr>
<tr><td rowspan="2">Airflow Requirements @ 55C[b]</td><td>Cable Type</td><td colspan="2">Hot Aisle - Heatsink to Port</td></tr>
<tr><td>Passive Cable</td><td colspan="2">300LFM</td></tr>
<tr><td></td><td>Active 0.8 Cable</td><td colspan="2">400LFM</td></tr>
<tr><td rowspan="5">Environmental</td><td rowspan="2">Temperature</td><td>Operational</td><td colspan="2">0°C to 55°C</td></tr>
<tr><td>Non-operational</td><td colspan="2">-40°C to 70°C</td></tr>
<tr><td rowspan="2">Humidity</td><td>Operational</td><td colspan="2">10% to 85% relative humidity</td></tr>
<tr><td>Non-operational</td><td colspan="2">10% to 90% relative humidity[c]</td></tr>
<tr><td>Altitude (Operational)</td><td colspan="3">3050m</td></tr>
<tr><td rowspan="3">Regulatory</td><td>Safety</td><td colspan="3">CB / cTUVus / CE</td></tr>
<tr><td>EMC</td><td colspan="3">CE / FCC / VCCI / ICES / RCM</td></tr>
<tr><td>RoHS</td><td colspan="3">RoHS compliant</td></tr>
<tr><td colspan="5">a. Typical power for ATIS traffic load.
b. Airflow is measured in wind tunnel. Contact NVIDIA for airflow numbers with other active modules' power levels.
c. The non-operational storage temperature specifications apply to the product without its package.</td></tr>
</table>

7.5 MCX623105AN-CDAT / MCX623105AE-CDAT / MCX623105AC-CDAT Specifications

ⓘ MCX623105AE-CDAT and MCX623105AN-CDAT have reached the end-of-life milestone.

<table>
<tr><td>Capabilities</td><td colspan="3">• MCX623105AN-CDAT: Crypto disabled, Secure Boot disabled
• MCX623105AE-CDAT: Crypto enabled, Secure Boot disabled
• MCX623105AC-CDAT: Crypto enabled, Secure Boot enabled</td></tr>
<tr><td>Physical</td><td colspan="3">Size: 5.59in. x 2.71in (142.00mm x 68.90mm)</td></tr>
<tr><td></td><td colspan="3">Connector: Single QSFP56 Ethernet (copper and optical)</td></tr>
<tr><td rowspan="2">Protocol Support</td><td>Data Rate:</td><td>Ethernet</td><td>1/10/25/40/50/100 Gb/s</td></tr>
<tr><td colspan="3">Ethernet: 100GBASE-CR2, 100GBASE-CR4, 100GBASE-KR4, 100GBASE-SR4, 100GBASE-LR4, 50GBASE-R2, 50GBASE-R4, 40GBASE-CR4, 40GBASE-KR4, 40GBASE-SR4, 40GBASE-LR4, 40GBASE-ER4, 40GBASE-R2, 25GBASE-R, 20GBASE-KR2, 10GBASE-LR,10GBASE-ER, 10GBASE-CX4, 10GBASE-CR, 10GBASE-KR, SGMII, 1000BASE-CX, 1000BASE-KX, 10GBASE-SR, 100GBASE-CR2, 100GBASE-KR2, 100GBASE-SR2</td></tr>
</table>

	PCI Express Gen 3.0/4.0: SERDES @ 16.0GT/s, 16 lanes (2.0 and 1.1 compatible)			
Power and Airflow [a]	**Voltage:** 3.3Aux **Maximum current:** 100mA			
	Power	Cable Type	PCIe Gen 3.0	PCIe Gen 4.0
	Typical Power	Passive Cables	15.67W	16.48W
	Maximum Power	Passive Cables	20.51W	22W
	Maximum power available through QSFP56 port: 5W (each port)			
	Altitude (Operational)	3050m		
	Airflow Requirements @ 55C[b]		Hot Aisle - Heatsink to Port	
		Passive Cable	500LFM	
		Active 3.5W Cable	600LFM	
Environmental	**Temperature**	Operational	0°C to 55°C	
		Non-operational	-40°C to 70°C	
	Humidity	Operational	10% to 85% relative humidity	
		Non-operational	10% to 90% relative humidity[c]	
	Altitude (Operational)	3050m		
Regulatory	**Safety**	CB / cTUVus / CE		
	EMC	CE / FCC / VCCI / ICES / RCM		
	RoHS	RoHS compliant		

a. Typical power for ATIS traffic load.
b. Airflow is measured in wind tunnel. Contact NVIDIA for airflow numbers with other active modules' power levels.
c. The non-operational storage temperature specifications apply to the product without its package

7.6 MCX623106AS-CDAT / MCX623106AN-CDAT / MCX623106AC-CDAT / MCX623106AE-CDAT Specifications

ⓘ MCX623106AE-CDAT has reached the end-of-life milestone.

Capabilities	• **MCX623106AS-CDAT:** Crypto disabled, Secure Boot enabled • **MCX623106AN-CDAT:** Crypto disabled, Secure Boot disabled • **MCX623106AC-CDAT[a]:** Crypto enabled, Secure Boot enabled • **MCX623106AE-CDAT:** Crypto enabled, Secure Boot disabled		
Physical	**Size**: 5.59in. x 2.71in (142.00mm x 68.90mm)		
	Connector: Dual QSFP56 Ethernet (copper and optical)		
Protocol Support	**Data Rate**:	Ethernet	1/10/25/40/50/100 Gb/s

	Ethernet: 100GBASE-CR2, 100GBASE-CR4, 100GBASE-KR4, 100GBASE-SR4, 100GBASE-LR4, 50GBASE-R2, 50GBASE-R4, 40GBASE-CR4, 40GBASE-KR4, 40GBASE-SR4, 40GBASE-LR4, 40GBASE-ER4, 40GBASE-R2, 25GBASE-R, 20GBASE-KR2, 10GBASE-LR,10GBASE-ER, 10GBASE-CX4, 10GBASE-CR, 10GBASE-KR, SGMII, 1000BASE-CX, 1000BASE-KX, 10GBASE-SR, 100GBASE-CR2, 100GBASE-KR2, 100GBASE-SR2			
	PCI Express Gen 3.0/4.0: SERDES @ 16.0GT/s, 16 lanes (2.0 and 1.1 compatible)			
Power and Airflow (b)	**Voltage:** 3.3Aux **Maximum current:** 100mA			
	Power	**Cable Type**	**PCIe Gen 3.0**	**PCIe Gen 4.0**
	Typical Power	Passive Cables	18.7W	19.52W
	Maximum Power	Passive Cables	25.28W	26.64W
	Maximum power available through QSFP56 port: 5W (each port)			
	Airflow Requirements @ 55C(c)		**Hot Aisle - Heatsink to Port**	
		Passive Cable	550LFM	
		Active 2.5W Cable	700LFM	
Environmental	**Temperature**	Operational	0°C to 55°C	
		Non-operational	-40°C to 70°C	
	Humidity	Operational	10% to 85% relative humidity	
		Non-operational	10% to 90% relative humidity(d)	
	Altitude (Operational)	3050m		
Regulatory	**Safety**	CB / cTUVus / CE		
	EMC	CE / FCC / VCCI / ICES / RCM		
	RoHS	RoHS compliant		

a. If your target application for this crypto-enabled card will utilize 100Gb/s or higher bandwidth, where a substantial part of the bandwidth will be allocated for IPsec traffic, please refer to the NVIDIA ConnectX-6 Dx Adapters Product Release Notes document to learn about a potential bandwidth limitation. See Related Documents section for details on accessing the document.
b. Typical power for ATIS traffic load.
c. Airflow is measured in wind tunnel. Contact NVIDIA for airflow numbers with other active modules' power levels.
d. The non-operational storage temperature specifications apply to the product without its package

7.7 MCX623106PN-CDAT / MCX623106PC-CDAT Specifications

ⓘ These products have reached the end-of-life milestone.

Capabilities	• **MCX623106PN-CDAT:** Crypto disabled, Secure Boot disabled, with PPS In/Out • **MCX623106PC-CDAT:** Crypto enabled, Secure Boot enabled, with PPS In/Out
Physical	**Size**: 5.59in. x 2.71in (142.00mm x 68.90mm)
	Connector: Dual QSFP56 Ethernet (copper and optical)

<table>
<tr><td rowspan="3">Protocol Support</td><td>Data Rate</td><td>Ethernet</td><td colspan="2">1/10/25/40/50/100 Gb/s</td></tr>
<tr><td colspan="4">Ethernet: 100GBASE-CR2, 100GBASE-CR4, 100GBASE-KR4, 100GBASE-SR4, 100GBASE-LR4, 50GBASE-R2, 50GBASE-R4, 40GBASE-CR4, 40GBASE-KR4, 40GBASE-SR4, 40GBASE-LR4, 40GBASE-ER4, 40GBASE-R2, 25GBASE-R, 20GBASE-KR2, 10GBASE-LR,10GBASE-ER, 10GBASE-CX4, 10GBASE-CR, 10GBASE-KR, SGMII, 1000BASE-CX, 1000BASE-KX, 10GBASE-SR, 100GBASE-CR2, 100GBASE-KR2, 100GBASE-SR2</td></tr>
<tr><td colspan="4">PCI Express Gen 3.0/4.0: SERDES @ 16.0GT/s, 16 lanes (2.0 and 1.1 compatible)</td></tr>
<tr><td rowspan="7">Power and Airflow (a)</td><td colspan="4">Voltage: 3.3Aux
Maximum current: 100mA</td></tr>
<tr><td>Power</td><td>Cable Type</td><td>PCIe Gen 3.0</td><td>Gen 4.0</td></tr>
<tr><td>Typical Power</td><td>Passive Cables</td><td>TBD</td><td>18.96W</td></tr>
<tr><td>Maximum Power</td><td>Passive Cables</td><td>TBD</td><td>26.64W</td></tr>
<tr><td colspan="4">Maximum power available through QSFP56 port: 5W (each port)</td></tr>
<tr><td rowspan="3">Airflow Requirements @ 55C(b)</td><td></td><td colspan="2">Hot Aisle - Heatsink to Port</td></tr>
<tr><td>Passive Cable</td><td colspan="2">600LFM</td></tr>
<tr><td>NVIDIA Active 2.5W Cable</td><td colspan="2">700LFM</td></tr>
<tr><td rowspan="5">Environmental</td><td rowspan="2">Temperature</td><td>Operational</td><td colspan="2">0°C to 55°C</td></tr>
<tr><td>Non-operational</td><td colspan="2">-40°C to 70°C</td></tr>
<tr><td rowspan="2">Humidity</td><td>Operational</td><td colspan="2">10% to 85% relative humidity</td></tr>
<tr><td>Non-operational</td><td colspan="2">10% to 90% relative humidity(c)</td></tr>
<tr><td>Altitude (Operational)</td><td colspan="3">3050m</td></tr>
<tr><td rowspan="3">Regulatory</td><td>Safety</td><td colspan="3">CB / cTUVus / CE</td></tr>
<tr><td>EMC</td><td colspan="3">CE / FCC / VCCI / ICES / RCM</td></tr>
<tr><td>RoHS</td><td colspan="3">RoHS compliant</td></tr>
<tr><td colspan="5">a. Typical power for ATIS traffic load.
b. Airflow is measured in wind tunnel. Contact NVIDIA for airflow numbers with other active modules' power levels.
c. The non-operational storage temperature specifications apply to the product without its package</td></tr>
</table>

7.8 MCX623106TC-CDAT / MCX623106TN-CDAT / MCX623106GN-CDAT / MCX623106GC-CDAT Specifications

MCX623106TN-CDAT and MCX623106GN-CDAT have reached the end-of-life milestone.

<table>
<tr><td>Capabilities</td><td colspan="4">MCX623106TC-CDAT[a]: Crypto enabled, Secure Boot enabled, with PPS In/Out and Enhanced-SyncE & PTP
MCX623106TN-CDAT: Crypto disabled, Secure Boot disabled, with PPS In/Out
MCX623106GN-CDAT: Crypto disabled, Secure Boot disabled, Enhanced-SyncE & PTP GM support and GNSS, PPS Out
MCX623106GC-CDAT[a]: Crypto enabled, Secure Boot enabled, with Enhanced-SyncE & PTP GM support and GNSS, PPS Out</td></tr>
<tr><td rowspan="2">Physical</td><td colspan="4">Size: 5.59in. x 2.71in (142.00mm x 68.90mm)</td></tr>
<tr><td colspan="4">Connector: Dual QSFP56 Ethernet (copper and optical)</td></tr>
<tr><td rowspan="3">Protocol Support</td><td>Data Rate:</td><td>Ethernet</td><td colspan="2">1/10/25/40/50/100 Gb/s</td></tr>
<tr><td colspan="4">Ethernet: 100GBASE-CR2, 100GBASE-CR4, 100GBASE-KR4, 100GBASE-SR4, 100GBASE-LR4, 50GBASE-R2, 50GBASE-R4, 40GBASE-CR4, 40GBASE-KR4, 40GBASE-SR4, 40GBASE-LR4, 40GBASE-ER4, 40GBASE-R2, 25GBASE-R, 20GBASE-KR2, 10GBASE-LR,10GBASE-ER, 10GBASE-CX4, 10GBASE-CR, 10GBASE-KR, SGMII, 1000BASE-CX, 1000BASE-KX, 10GBASE-SR, 100GBASE-CR2, 100GBASE-KR2, 100GBASE-SR2</td></tr>
<tr><td colspan="4">PCI Express Gen 3.0/4.0: SERDES @ 16.0GT/s, 16 lanes (2.0 and 1.1 compatible)</td></tr>
<tr><td rowspan="9">Power and Airflow [b]</td><td colspan="4">Voltage: 12V</td></tr>
<tr><td>Power</td><td>Cable Type</td><td>PCIe Gen 3.0</td><td>PCIe Gen 4.0</td></tr>
<tr><td>Typical Power[b]</td><td>Passive Cables</td><td>TBD</td><td>18.96W</td></tr>
<tr><td>Maximum Power</td><td>Passive Cables</td><td>TBD</td><td>26.64W</td></tr>
<tr><td colspan="4">Maximum power available through QSFP56 port: 5W (each port)</td></tr>
<tr><td colspan="4">Voltage: 3.3Aux
Maximum current: 100mA</td></tr>
<tr><td rowspan="4">Airflow Requirements @ 55C[c]</td><td></td><td colspan="2">Hot Aisle - Heatsink to Port</td></tr>
<tr><td>Passive Cable</td><td colspan="2">550LFM</td></tr>
<tr><td>Active 2.5W Cable</td><td colspan="2">700LFM</td></tr>
<tr><td>Active 3.5W Cable</td><td colspan="2">1100LFM</td></tr>
<tr><td rowspan="5">Environmental</td><td rowspan="2">Temperature</td><td>Operational</td><td colspan="2">0°C to 55°C</td></tr>
<tr><td>Non-operational</td><td colspan="2">-40°C to 70°C</td></tr>
<tr><td rowspan="2">Humidity</td><td>Operational</td><td colspan="2">10% to 85% relative humidity</td></tr>
<tr><td>Non-operational</td><td colspan="2">10% to 90% relative humidity[d]</td></tr>
<tr><td>Altitude (Operational)</td><td>3050m</td><td colspan="2"></td></tr>
<tr><td rowspan="3">Regulatory</td><td>Safety</td><td colspan="3">CB / cTUVus / CE</td></tr>
<tr><td>EMC</td><td colspan="3">CE / FCC / VCCI / ICES / RCM</td></tr>
<tr><td>RoHS</td><td colspan="3">RoHS compliant</td></tr>
<tr><td colspan="5">a. If your target application for this crypto-enabled card will utilize 100Gb/s or higher bandwidth, where a substantial part of the bandwidth will be allocated for IPsec traffic, please refer to the NVIDIA ConnectX-6 Dx Adapters Product Release Notes document to learn about a potential bandwidth limitation. See Related Documents section for details on accessing the document.
b. Typical power for ATIS traffic load.
c. Airflow is measured in wind tunnel. Contact NVIDIA for airflow numbers with other active modules' power levels.
d. The non-operational storage temperature specifications apply to the product without its package</td></tr>
</table>

7.9 MCX623105AC-VDAT / MCX623105AN-VDAT / MCX623105AS-VDAT / MCX623105AE-VDAT Specifications

ⓘ MCX623105AS-VDAT and MCX623105AE-VDAT have reached the end-of-life milestone.

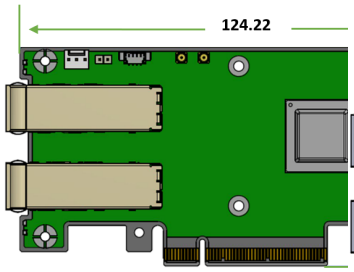
<table>
<tr><td>Capabilities</td><td colspan="4">• MCX623105AC-VDAT[a]: Crypto enabled, Secure Boot enabled
• MCX623105AN-VDAT: Crypto disabled, Secure Boot disabled
• MCX623105AS-VDAT: Crypto disabled, Secure Boot enabled
• MCX623105AE-VDAT: Crypto enabled, Secure Boot disabled</td></tr>
<tr><td rowspan="2">Physical</td><td colspan="4">Size: 5.59in. x 2.71in (142.00mm x 68.90mm)</td></tr>
<tr><td colspan="4">Connector: Single QSFP56 Ethernet (copper and optical)</td></tr>
<tr><td rowspan="3">Protocol Support</td><td>Data Rate:</td><td>Ethernet</td><td colspan="2">1/10/25/40/50/100/200 Gb/s</td></tr>
<tr><td colspan="4">Ethernet: 200GBASE-CR4, 200GBASE-KR4, 200GBASE-SR4, 100GBASE-CR2, 100GBASE-CR4, 100GBASE-KR4, 100GBASE-SR4, 100GBASE-LR4, 50GBASE-R2, 50GBASE-R4, 40GBASE-CR4, 40GBASE-KR4, 40GBASE-SR4, 40GBASE-LR4, 40GBASE-ER4, 40GBASE-R2, 25GBASE-R, 20GBASE-KR2, 10GBASE-LR,10GBASE-ER, 10GBASE-CX4, 10GBASE-CR, 10GBASE-KR, SGMII, 1000BASE-CX, 1000BASE-KX, 10GBASE-SR, 100GBASE-CR2, 100GBASE-KR2, 100GBASE-SR2</td></tr>
<tr><td colspan="4">PCI Express Gen 3.0/4.0: SERDES @ 16.0GT/s, 16 lanes (2.0 and 1.1 compatible)</td></tr>
<tr><td rowspan="8">Power and Airflow (b)</td><td colspan="4">Voltage: 3.3Aux
Maximum current: 100mA</td></tr>
<tr><td>Power</td><td>Cable Type</td><td>PCIe Gen 3.0</td><td>Gen 4.0</td></tr>
<tr><td>Typical Power</td><td>Passive Cables</td><td>TBD</td><td>16.94W</td></tr>
<tr><td>Maximum Power</td><td>Passive Cables</td><td>TBD</td><td>24W</td></tr>
<tr><td colspan="4">Maximum power available through QSFP56 port: 5W (each port)</td></tr>
<tr><td rowspan="3">Airflow Requirements @ 55C[c]</td><td></td><td colspan="2">Hot Aisle - Heatsink to Port</td></tr>
<tr><td>Passive Cable</td><td colspan="2">600LFM</td></tr>
<tr><td>Active 4.55W Cable</td><td colspan="2">950LFM</td></tr>
<tr><td rowspan="5">Environmental</td><td rowspan="2">Temperature</td><td>Operational</td><td colspan="2">0°C to 55°C</td></tr>
<tr><td>Non-operational</td><td colspan="2">-40°C to 70°C</td></tr>
<tr><td rowspan="2">Humidity</td><td>Operational</td><td colspan="2">10% to 85% relative humidity</td></tr>
<tr><td>Non-operational</td><td colspan="2">10% to 90% relative humidity[d]</td></tr>
<tr><td>Altitude (Operational)</td><td colspan="3">3050m</td></tr>
<tr><td rowspan="3">Regulatory</td><td>Safety</td><td colspan="3">CB / cTUVus / CE</td></tr>
<tr><td>EMC</td><td colspan="3">CE / FCC / VCCI / ICES / RCM</td></tr>
<tr><td>RoHS</td><td colspan="3">RoHS compliant</td></tr>
</table>

a. If your target application for this crypto-enabled card will utilize 100Gb/s or higher bandwidth, where a substantial part of the bandwidth will be allocated for IPsec traffic, please refer to the NVIDIA ConnectX-6 Dx Adapters Product Release Notes document to learn about a potential bandwidth limitation. See Related Documents section for details on accessing the document.
b. Typical power for ATIS traffic load.
c. Airflow is measured in wind tunnel. Contact NVIDIA for airflow numbers with other active modules' power levels.
d. The non-operational storage temperature specifications apply to the product without its package

7.9.1 Board Mechanical Drawing and Dimensions

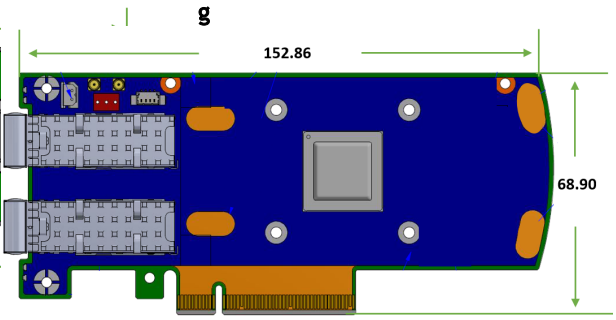
⚠ All dimensions are in millimeters. Mechanical tolerances are specified for each form factor.

Dual-Port SFP28/SFP56 x8 Adapter Cards



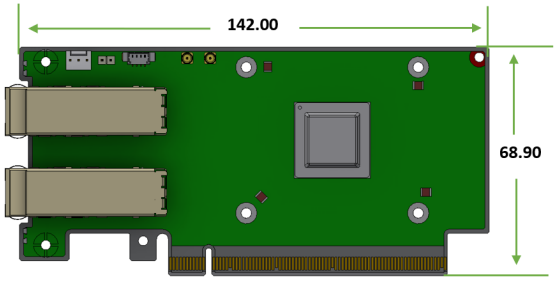
Mechanical Drawing
Mechanical Tolerance:
Width: +/- 0.13mm
Height: +0/-0.13mm

Dual-Port SFP28 x8 Adapter Cards with Active Cooling



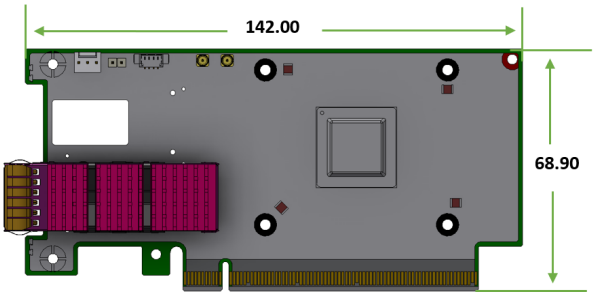
Mechanical Tolerance:
Width: +/- 0.13mm
Height: +0/-0.2mm

Dual-Port SFP28/SFP56 x16 Adapter Cards Mechanical Drawing

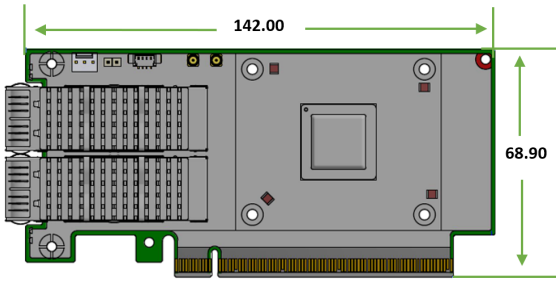


Mechanical Tolerance:
Width: +/- 0.13mm
Height: +0/-0.13mm

Single-Port QSFP56 x16 Adapter Cards Mechanical Drawing

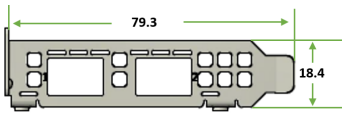
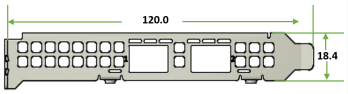
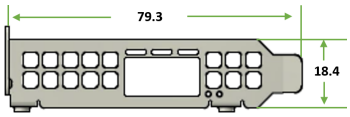
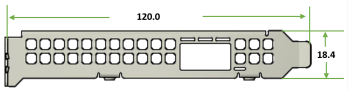
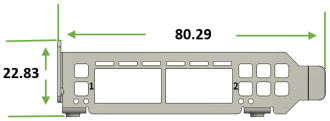
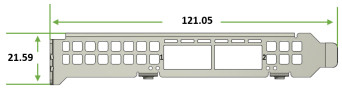


Mechanical Tolerance:
Width: +/- 0.13mm
Height: +0/-0.13mm

Dual-Port QSFP56 x16 Adapter Cards Mechanical Drawing	
 Mechanical Tolerance: Width: +/- 0.13mm Height: +0/-0.13mm	

7.9.2 Bracket Mechanical Drawing

All dimensions are in millimeters. All the mechanical tolerances are +/- 0.2mm.

Card Configuration	Short Bracket	Tall Bracket
Dual-Port SFP28/SFP56 Cards		
Single-Port QSFP56 Cards		
Dual-Port QSFP56 Cards		

8 Monitoring

8.1 Thermal Sensors

The adapter card incorporates the ConnectX IC, which operates in the range of temperatures between 0°C and 105°C.

Three thermal threshold definitions impact the overall system operation state:

- Warning – 105°C: On managed systems only: When the device crosses the 105°C threshold, a Warning Threshold message is issued by the management SW, indicating to system administration that the card has crossed the warning threshold. Note that this temperature threshold does not require nor lead to any action by hardware (such as adapter card shutdown).
- Critical – 115°C: When the device crosses this temperature, the firmware automatically shuts down the device.
- Emergency – 130°C: If the firmware fails to shut down the device upon crossing the critical threshold, the device automatically shuts down upon crossing the emergency (130°C) threshold.

The card's thermal sensors can be read through the system's SMBus. The user can read these thermal sensors and adapt the system airflow following the readouts and the needs of the above-mentioned IC thermal requirements.

8.2 Adapter Card Heatsink

The heatsink is attached to the ConnectX-6 Dx IC in order to dissipate the heat. It is attached either by using four spring-loaded push pins that insert into four mounting holes, or by screws. ConnectX-6 Dx IC has a thermal shutdown safety mechanism that automatically shuts down the ConnectX-6 Dx card in cases of high-temperature event, improper thermal coupling or heatsink removal.
For the required airflow (LFM) per OPN, please refer to the Specifications chapter.

9 Finding the MAC on the Adapter Card

Each NVIDIA adapter card has a different identifier printed on the label: serial number and the card MAC for the Ethernet protocol.

> ⚠ The product revisions indicated on the labels in the following figures do not necessarily represent the latest revisions of the cards.

MCX623105AS-VDAT Board Label Example

10 Document Revision History

Date	Description of Changes
Mar. 2025	Updated that LED behavior in Networking Ports LEDs Interface Updated the Legacy (EOL) Ordering Part Numbers
Jan. 2023	Updated the dual-port QSFP56 bracket mechanical drawing in Specifications
Nov. 2023	Added the 100GBASE-CR2 protocol in Specifications tables
Jul. 2023	Updated Ordering Part Numbers table
Jun. 2023	Added important notes on selected OPNs in Ordering Part Numbers and the Specifications chapter
May. 2023	Updated Specifications to include non-operational storage temperature specifications
Aug. 2022	Updated the "Legacy (EOL) Ordering Part Numbers" table.
Jun. 2022	Updated board and bracket mechanical drawings and mechanical tolerances.
Mar. 2022	Added the following OPNs to relevant sections: • MCX621202AS-ADAT • MCX621202AC-ADAT
Jan. 2022	Added table "Legacy (EOL) Ordering Part Numbers"
Sept. 2021	Added OPN MCX623105AC-CDAT Updated Specifications table format.
Aug. 2021	Added the following OPNs: • MCX623106TN-CDAT • MCX623106TC-CDAT • MCX623106GN-CDAT • MCX623106GC-CDAT • MCX621202AS-ADAT • MCX621202AC-ADAT
Jun. 2021	Updated Interfaces.
Mar. 2021	Updated Troubleshooting.
Mar. 2021	Updated Protocol Support in Specifications.
Mar. 2021	Added OPN MCX623102AS-ADAT
Feb. 2021	Updated MCX623102A[C/N/S/E]-GDAT airflow numbers.
Dec. 2020	Updated cards' dimensions for MCX621102A[C/E/N]-ADAT.
Sep. 2020	Updated power numbers in Specifications.
Aug. 2020	Updated power numbers in Specifications.
Aug. 2020	Updated LED specifications in Specifications.
Jul. 2020	Updated power numbers in Specifications.
Jul. 2020	Updated power numbers in Specifications.

Date	Description of Changes
Jun. 2020	Updated airflow numbers. Added the following OPNs to all relevant sections: • MCX621102AE-ADAT • MCX623102AS-GDAT • MCX623102AC-GDAT • MCX623106AE-CDAT • MCX623106PC-CDAT • MCX623106PN-CDAT • MCX623106PE-CDAT • MCX623105AE-VDAT
May. 2020	Updated power numbers.
Feb. 2020	Added the following OPNs to all relevant sections: • MCX623106AS-CDAT • MCX623105AS-VDAT • MCX623102AS-GDAT
Nov. 2019	First release

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